Confederation of Indian Industry

# CII Industry–Academia Partnership Compendium 2025

Successful Case Studies of Collaboration & Co-Creation between Industry & Indian Academia

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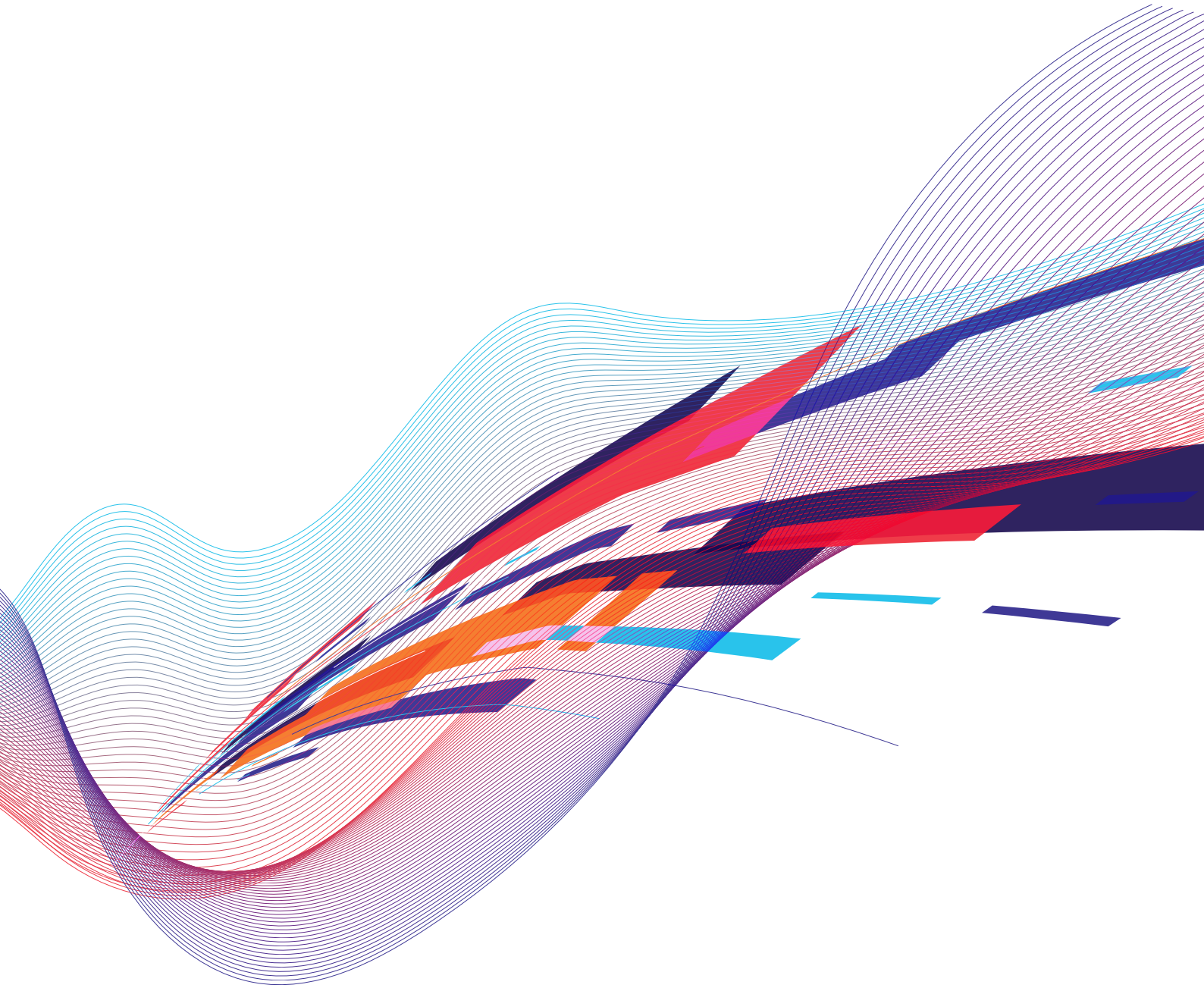

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# FOREWORD BY TASKFORCE CHAIR

**Dr. Naushad Forbes**
Chairman – CII National Forum on Industry–Academia Partnership Co-Chairperson, Forbes Marshall

In 2025, as India accelerates its journey toward becoming a global hub of innovation and technological excellence, the collaboration between industry and academia has never been more vital. The convergence of industrial expertise, academic research, and entrepreneurial energy is the cornerstone of a knowledge-driven economy. It is through such partnerships that we can address complex societal challenges, foster inclusive growth, and strengthen India's position in the global innovation ecosystem.

The CII National Forum on Industry–Academia Partnership continues to champion this mission. The Forum serves as a platform that connects industry, academia, research laboratories, and startups—what we term the National Research Quad—with the government playing an enabling and facilitative role. Together, this ecosystem is shaping the future of Indian research, development, and innovation.

This 2025 Compendium brings together a diverse collection of case studies that exemplify the spirit of collaboration across key sectors. Each story reflects commitment, creativity, and perseverance—illustrating how shared purpose and partnership can translate into tangible outcomes for both society and the economy. We hope these examples inspire new ideas, deepen cooperation, and encourage more organizations to embark on similar journeys.

I extend my sincere appreciation to all members of the Forum, our knowledge partners, and every contributor whose efforts have made this compendium possible. Your continued engagement and enthusiasm reaffirm our collective belief that when industry and academia work together, the possibilities for innovation are limitless.

# MESSAGE FROM AWARD CHAIR

**Vipin Sondhi**
Former Chairperson, CII National Forum on Industry–Academia Partnership for R&D and Innovation

India stands at a defining moment in its growth journey. As the nation continues to experience unprecedented economic expansion, it must also navigate a rapidly evolving global landscape shaped by technological disruption, climate challenges, and shifting market dynamics. To remain resilient and future-ready, reimagination and reinvention are essential—and at the heart of this transformation lies strategic collaboration between industry and academia.

In this context, partnerships between industry and academia are not merely desirable—they are indispensable. They empower us to see what everyone sees but to think differently, innovate boldly, and execute decisively. By working in concert, academia brings depth of research and fresh ideas, while industry contributes scale, application, and execution excellence. Together, they have the potential to not only shape India's economic and technological trajectory but also create meaningful global impact.

This 2025 Compendium of industry–academia partnerships is a testament to what can be achieved through such collaboration. It presents diverse case studies that highlight the objectives, processes, technologies, and outcomes of joint research and innovation efforts across sectors. These examples underscore how partnerships can turn ideas into tangible solutions—addressing societal challenges, improving productivity, and enhancing the quality of life.

The insights from these initiatives also provide valuable policy directions—from incentivizing collaborative R&D and streamlining technology transfer frameworks, to fostering skill development and recognizing cross-sectoral achievements. Implementing these measures will be vital to realizing India's aspiration of becoming a USD 35 trillion economy by 2047.

I extend my gratitude to the CII team and all members of the Forum for their sustained commitment to strengthening India's innovation ecosystem. I hope this Compendium inspires new collaborations and reaffirms our shared conviction that innovation, when guided by partnership and purpose, can truly build a better future for all.

# MESSAGE FROM CII DIRECTOR GENERAL

**Chandrajit Banerjee**
Director General
Confederation of Indian Industry (CII)

India's journey toward Viksit Bharat @2047 depends on strengthening research, development, and innovation. Achieving this vision calls for deep collaboration between industry, academia, research institutions, and startups— together forming what CII envisions as the National Research Quad. The Government acts as a key facilitator and enabler. Such synergy is central to India's transformation.

Academia brings depth of inquiry and scientific rigor, while industry offers practical experience, scale, and implementation capability. Together, we can create a powerful ecosystem that boosts India's competitiveness and positions it as a global leader in technology and innovation.

The CII Industry–Academia Partnership Compendium 2025 reflects this vision. It demonstrates how collaboration between research and industry drives meaningful outcomes. Case studies in this edition show how academic excellence and industry expertise create new knowledge, deliver technological breakthroughs, and benefit society at large.

CII would like to extend its sincere appreciation to all contributors—industry leaders, academic institutions, researchers, and innovators—who have shared their experiences and success stories for this compendium. Their commitment exemplifies the spirit of partnership that is essential to building an innovation-driven economy.

As we look ahead, we hope this compendium informs, inspires and sparks deeper dialogue and action. Through stronger partnerships and sustained collaboration, we can advance knowledge, accelerate India's innovation journey, and realise our aspiration of a developed nation by 2047.

# EXECUTIVE SUMMARY

## CII Industry–Academia Partnership Compendium 2025

India's ambition to become an innovation-led, globally competitive economy requires a deeply interconnected ecosystem where industry, academia, research labs, and startups collaborate with purpose and urgency. As the nation advances toward the vision of Viksit Bharat @2047, the ability to convert research into market-ready technologies, scalable enterprises, and future-ready talent becomes indispensable.

The CII National Forum on Industry–Academia Partnership continue to catalyse this transformation by strengthening what we call the National Research Quad. The 2025 edition of the Compendium, comprising 34 case studies, showcases collaborations that exemplify how structured partnerships can accelerate technology development, enhance industrial competitiveness, and create societal value.

### India's Innovation Paradox

India ranks among the world's top nations in scientific output. Yet, according to the 2024 Global Innovation Index (GII), the country stands at 86th place on industry–academia collaboration, reflecting a persistent gap between research capability and industrial application. Meanwhile, although India hosts more than 120 unicorns, only 5% are IP-led, signalling the urgent need to shift from a demographic dividend to an innovation dividend driven by deep science, technology development, and scalable intellectual property.

### What the 34 Case Studies Reveal

This year's case studies represent partnerships with organizations such as NOCIL, Forbes Marshall, IBM, Ceat, INOX Air Products, Bharat Forge, Climate ETC, Accenture, GREW Energy, BFW, Mahindra, ITC, Tata Chemicals, Alpla, Cummins, Pearson, Continental, Lam Research, DCM Shriram, ITC (Foods), leading IITs, and many others.

**Collectively, the case studies highlight:**

- **Accelerated technology translation,** with innovation projects progressing from prototypes toward commercialization and advanced Technology Readiness Levels (TRLs).
- **Strengthening India's IP ecosystem,** with collaborative efforts resulting in new patents, process innovations, algorithms, materials, and digital technologies.
- **Startups emerging as critical conduits** between academia's research output and industry's need for implementable solutions—while still requiring support to cross the "valley of death."
- **Real-world outcomes,** including improved manufacturing processes, sustainability solutions, next-generation materials, agritech innovations, AI-driven systems, and advanced engineering applications.
- **New models for skilling,** where academia and industry codesign programmes to address the country's widening skill gap, especially in sectors like semiconductors, robotics, and advanced manufacturing.

These cases show that innovation is strongest when rooted in co-creation, grounded in real industrial challenges, and supported through technology transfer, piloting, and structured engagement.

### The Ecosystem Imperatives

Across the cases and stakeholder dialogues, several consistent themes emerge:

- **Policy incentives** are essential to motivate greater industry investment in R&D, IP creation, and collaborative projects.
- **MSMEs can serve as test beds,** enabling technology validation and faster scaling.

- **Awareness remains limited**—many academic innovations remain invisible to industry due to disconnects in communication channels.
- **Cultural differences persist,** with academia working on long-term scientific problems and industry seeking fast, monetizable outcomes.
- **Administrative constraints** prevent private-sector experts from contributing meaningfully within academic structures, including PhD supervision roles.
- **A dedicated systemic reforms cell within ANRF** could play a catalytic role in addressing these barriers and enabling frictionless collaboration.

## The Purpose of the 2025 Compendium

The **CII Industry–Academia Partnership Compendium 2025** aims to:

- Provide a national repository of proven collaborative models.
- Showcase how diverse industries and academic institutions are jointly solving India's pressing challenges.
- Offer actionable insights to guide future partnerships, policy reforms, and institutional strategies.
- Inspire new engagements that push India toward an innovation-centric economic model.

The 34 case studies—ranging from sustainable materials and advanced coatings to digital supply chains, agritech solutions, semiconductor readiness, and robotics—demonstrate the power of shared purpose. They highlight that when India's scientific talent, industrial expertise, and entrepreneurial energy come together, they produce innovation that is scalable, competitive, and globally relevant.

## A Call to Action

India's innovation potential is immense. To fully realize it, we must strengthen the connective tissue between research and industry, remove systemic bottlenecks, and cultivate a culture of trust, openness, and shared value.

The 2025 Compendium reinforces a central message:

**Research finds meaning when paired with industry, and industry achieves impact when powered by research.**

Together, they will determine India's trajectory as a knowledge-driven, innovation-led economy in the decades ahead.

# NOCIL

## An Engineered Electrode of Phenazine with a Suitable Cathode Material for Battery Applications

**Type of Partnership:**
Industry Sponsored Research project

**Start Year of Partnership:**
2024

**Leader Name:**
Dr. Vikas Padalkar
Head R&D
prasanna.pandit@nocil.com

**Current Status:**
Completed

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  Novel Material for redox-flow batteries: Automobile Sector, Energy Storage Sector
- **Academic Partner Name:**
  University of Mumbai, Centre for Nanoscience and Nanotechnology
- **Faculty Name:**
  Prof. Pravin Walke
- **Overall Cost:**
  1550000
- **Financial Benefits Realised:**
  Not Applicable
- **TRL:** 5

- **Situation:**
  NOCIL: Novel redox material developed in lab, validated in pilot plant and manufactured in plant; University of Mumbai: Material evlauted as cathod material, coin-cell fabricated, lab-proto type device made, validation and improvements is in progress.
- **Task and Technology Used:**
  Novel Material as cathode material for battery (energy storage devices).
- **Actions Undertaken:**
  Process for material generation is validated and ready for commercialization; Material as cathode material, validation work is in progress.
- **Results/Outcome:**
  Novel Material and its use in Battery Material.
- **Impact:**
  Inhouse Material availability locally- Import substitute. Material is very stable and can be used for more cycles. Substantial saving is investigated.
- **Describe Industry-Academia Partnership Challenges Faced During this Collaboration:**
  Try-academic partnership since long time (Since 1987) and not faced any challenges for this project.

- **Key Learnings:**
  - Establishment of dedicated technology transfer facilitation offices.
  - Government incentives for joint research projects.
  - Creation of industry-specific research hubs in universities.
  - Development of specialized courses aligned with industry needs.

# FORBES MARSHALL PRIVATE LIMITED

## Industrial Wastewater Treatment with Low Energy Intensity for Apvt. Chemical Organization

**Type of Partnership:**
Industry Sponsored Consulting by Faculty

**Start Year of Partnership:**
2024

**Leader Name:**
Shripad Kulkarni

sdkulkarni@forbesmarshall.com

**Current Status:**
In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  All the process industries customers especially pharma and chemical, food and beverage, and textile industries.
- **Academic Partner Name:**
  IISc Bengaluru
- **Faculty Name:**
  Sanjiv Sambandan
- **Overall Cost:**
  9000000
- **Financial Benefits Realised:**
  Not Applicable
- **TRL:** 7

- **Situation:**
  Forbes Marshall is a leading energy conservation solution provider, role here is connecting with customers and making available the customer access, IISc bengaluru consulting institute for the project.

- **Task and Technology Used:**
  End outcome expected is able to treat hard to abate waste water for industrial institute.

- **Actions Undertaken:**
  Preliminary trials are done, results are promising.

- **Results/Outcome:**
  Detailed engineering solution is proposed and under evaluation.

- **Impact:**
  Waste water can be reused in the process, the typical impact is saving of around 2Cr/ anuum worth of steam.

- **Describe Industry-Academia Partnership Challenges Faced During this Collaboration:**
  The time and the overall framework and documentation approval requirements to get involved in such partnership is a big challenge.

- **Key Learnings:**
  - Standardise the collaboration models for further motivation.

# IBM INDIA PVT LTD

## IBM SkillsBuild

**Type of partnership:** Industry Sponsored CSR

**Start Year of Partnership:** 2023

**Leader Name:** Sandip Patel

Shipra.Sharma@ibm.com

**Current Status:** Completed

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  Students of M.Tech 2nd Year students
- **Academic Partner Name:**
  International Institute of Information Technology, Bangalore
- **Faculty Name:**
  Dr. Madhav Rao, Dr. T K Srikanth
- **Overall Cost:**
  1400000
- **Financial Benefits realised:**
  App under validation testing for NIMHANS
- **TRL:** 9

- **Situation:**
  International Institute of Information Technology, Bangalore (IIITB) worked with Specialists in National Institute of Mental Health and Neuro Sciences(NIMHANs) for medically validated datasets and IBM experts to come up with Best AI model usage for deduction of mental state.
- **Task and Technology Used:**
  Task - Creating Synthetic data sets and training Large Language Model (LLM). Technology - Large Language Model, Synthetic data sets.
- **Actions Undertaken:**
  Researchers in IIITB, worked with Medical professional from NIMHANS for labeling dataset from real time patients. This sample was then used to create Synthetic datasets.
- **Results/Outcome:**
  Outcome: This research work was concluded to have LLM trained using real world and synthetic datasets to summarize human mental states for the Statements written by Patients and categorize it to depression or not.
- **Impact:**
  Research/Investigates two important features for engineering AI based mental-health screening of text, supplied by the help seekers. The tool in the future is expected to aid the psychiatrist fraternity by prioritizing the needy ones.
- **Describe Industry-Academia Partnership Challenges Faced During this Collaboration:**
  Mental health datasets are very difficult to get hands on, and it was really a task to remove all the personal information for making this data set research ready. Working with different departs within different research institutions (IIITB) and (NIMHANS) and getting legal clearance for specific tasks of data-processing tasks was a tedious activity. There on the size of the synthetic dataset required to optimally train the Open Source LLM was also a compurtationally ardent task.
- **Key Learnings:**
  Industry should engage and participate in such academia lead research projects, and from the learnings engage more Open Innovation Challenges for the student community. When this project was initiated, there were barely any open LLMs available and as more and more open LLMs came into the market - Such projects became a beacon of hope to try out the best solutions and democratize solutioning in the Mental health domain. This also assisted the Industry mentor to take on newer roles of Policy and Advocacy Initiatives with IIITB, Government of Karnataka.

# CEAT LIMITED

## Development of Self-Healing Polymer for Self-Repairing tyre

**Type of partnership:**
Phd Scholarship Sponsored by Industry Under PM Fellowship

**Start Year of Partnership:**
2025

**Leader Name:**
Sambhu Bhadra

sambhu.bhadra@ceat.com

**Current Status:**
In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  User of "Four wheeler car" includes retail customers and OEMs.
- **Academic Partner Name:**
  IIT Kharagpur
- **Faculty Name:**
  Prof. N. K. Singha
- **Overall Cost:**
  3186000
- **Financial Benefits Realised:**
  Under implementation
- **TRL:** 4

- **Situation:**

**Objectives:**

1. To explore different new routes to modify commercial elastomers to introduce the reversible network in the modified elastomers.
2. The reversible network will be reversible to heat and/or UV radiation.
3. To analyse the modified elastomers via NMR, FT-IR, DSC and DMA analyses.
4. Their processibility will be studied via RPA analysis.
5. The self-healing as well as recyclability will be studied. Mr. Subhendu Pramanik, junior research fellow is working on this project. He has also received PM Fellowship. He is responsible for literature search, project planning, execution of laboratory experiment at IIT, preparing report and submit to CEAT. Prof. N. K. Singha is Subhendu's supervisor from IIT. He is guiding Subhendu with new insights. Dr. Sambhu Bhadra from CEAT side is guiding Subhendu with new ideas, tyre formulation, how self-healing materials will work in tyre. After completing laboratory experiments at IIT and screening suitable material, Dr. Sambhu will validate it at CEAT's laboratory.

- **Task and Technology Used:**
  Because of the self-healing nature of the polymer, the damaged tyre will self-repair.
- **Actions Undertaken:**
  Experiments started at IIT, Kharagpur. Several materials were screened and their self-healing properties are measured. With those materials second level laboratory validation is in progress at CEAT's laboratory.
- **Results/Outcome:**
  Few materials were identified, which are showing self-healing characteristics.
- **Impact:**
  The concept is under implementation. Impact is not yet realized. However, it is expected to enhance tyre life and reduce tyre wear particle (TWP), thereby helping the environment with less TWP and less scrap.
- **Describe Industry-Academia Partnership Challenges Faced During this Collaboration:**
  Identifying suitable self-healing polymer is a big challenge. Getting self-healing properties in vulcanized rubber compound is bigger challenge.

- **Key Learnings:**
  Self-healing chemistry and dynamics.

# INOX AIR PRODUCTS PRIVATE LIMITED

## IIT Delhi (Chemical) - Research Facility Development for Conducting Cutting-Edge Research in the Filed of Sustainability, Energy Generation and Storage and Novel Material Synthesis. IIT Delhi (Energy) - Integration of Various Renewable Energy Sources through AC-DC Hybrid Microgrid

**Type of partnership:**
Industry Sponsored CSR

**Start Year of Partnership:**
2023

**Leader Name:**
Mr. Siddharth Jain

jainsk@inoxap.com

**Current Status:**
In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  IIT Delhi (Chemical) - Faculties (15), Research scholars (50)
- **Academic Partner Name:**
  IIT Delhi
- **Faculty Name:**
  Mr. Rathore (IIT Delhi Chemical)/Mr. Vamsi (IIT Delhi Energy)
- **Overall Cost:**
  29150000
- **Financial Benefits Realised:**
  Not Applicable
- **TRL:** 5

- **Situation:**
  IIT Delhi Chemical - INOX awarded the CSR funding to develop a research facility. Based on the proposal from chemical engineering, 8 equipments were procured. These equipments are of high-usage for faculties in the department of chemical engineering which are actively used for research purposes. Firstly, research scholars are trained and subsequently they conduct research in the field of sustainability, energy transition and storage, helathcare and novel material synthesis. INOX has facilitated the funding, Chemical engineering have provided space to create cutting edge reserach lab named "Inox Chemical Engineering Research Laboratory". Key users of this facility is faculty members and research scholar. IIT Delhi (Energy) - This is an academic project for helping IIT students in learning various fundamental and advanced concepts regarding energy sector and its integration with national electric grid.

- **Task and Technology Used:**
  IIT Delhi (Chemical) - Research conducted in this facility will be used for developing technologies for CCUS, hydrogen production, energy storage, healthcare solutions and new material developments. IIT Delhi (Energy) - The CSR contribution was used for the development of demonstration setup on the proposed theme.

- **Actions Undertaken:**
  IIT Delhi (Chemical) - Chemical engineering, IIT Delhi received funding in 2 tranches of INR 1,93,50,000 and INR 2,50, 00,000. The department proceed to procure following equipments: 1) Alkaline Water Electrolysis through In-situ Raman Spectroscopy with Electrochemical Test 2) X-ray Diffractometer 3) Research and Development of Two-dimensional Bismuth Oxyselenide ($Bi_2O_2Se$) based Electronic and Optoelectronic Devices 4) Research in Chemical Engineering through Molecular and Particle-Level Simulations 5) Inductively Coupled Plasma Mass Spectrometry ICP-MS 6) Inductively Coupled Plasma Mass Spectrometry (ICP-OES) 7) Electronics, optoelectronics, and thermoelectrics of two-dimensional Nanomaterials through Cryogenic Probe

Stage 8) Experimental setup to study flow behavior and stratification of hydrogen-natural gas mixtures in gas pipelines. All equiments are installed except cryogenic probe stage and reactor set-up. In order to setup all these equipment, Chemical Engineering has developed the complete facility with all other infrastructure. IIT Delhi (Energy) - The Hardware of this set-up is under progress.

### Results/Outcome:

IIT Delhi Chemicals - 1) More than 50 research scholars are trained on new facilities 2) More than 15 papers have been published using equipment from this facility. 3) Facility reduced the waiting time for conducting sample anaylsis using central facility. Effectively, it enhanced the speed of research and thus saving time. 4) Facility facilitated improving the quality of research using new equipments. IIT Delhi (Energy) - The Contribution has resulted in Patents/ journal and conference proceedings.

### Impact:

IIT Delhi (Chemicals) - 1) This facility will help attract more projects based on current facility. 2) More than 50 research scholars are trained on new facilities 3) More than 15 papers have been published using equipment from this facility. 4) Facility reduced the waiting time for conducting sample anaylsis using central facility. Effectively, it enhanced the speed of research and thus saving time. 5) Facility facilitated improving the quality of research using new equipments. IIT Delhi (Energy) - It has huge environmental impact in formulating a new grid code where efficiency of various renewable power generation can be significantly improved.

### Describe Industry-Academia Partnership Challenges Faced During this Collaboration:

IIT Delhi (Chemicals) - This collaboration has been executed smoothly. IIT Delhi obtained funding which was subsequently used for procurement. The timeline could be slightly better since puchasing is a long process, hence the efforts can be made to streamline the process. Another aspect that needs attention is sustainance of such facility in terms of manpower support and annual maintenance support. There is need of developing sustainable model for long term effect. IIT Delhi (Energy) - None

### Key Learnings:

IIT Delhi (Chemicals) - It is a great step towards building infrastructure and collaboration between industry-acadmia. Its impact will be felt in the short and long term in strengthening the research ecosystem in academia. The contribution from INOX has a strong impact on entire Institute instead of just a few individuals. After building the highly advanced research facility, targeted projects can be envisaged in consortium mode to make it more effective and focused. This will require regular interactions. A stronger mode of communication has to be devised to keep these efforts progressing. A commitment of 10 years of collaboration will sustain the research and development effort for next 20 years. IIT Delhi (Energy) - Since the setup created from the contribution is still under progress, the impact will be realized at a later stage for various stake holders in the energy sector.

# BHARAT FORGE LTD

## Development of Mine Blast-Proof Hybrid Composite

**Type of partnership:** Industry Sponsored Research Project

**Start Year of Partnership:** 2024

**Leader Name:**
Dr. Rajkumar Singh
Senior Director
RajkumarSingh@bharatforge.com

**Current Status:** In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  The primary users and beneficiaries of this partnership and innovation are:
  - Indian Armed Forces: Indian Army, Indian Navy and Indian Air Force.
  - Para-Military Forces: Border Security Force (BSF), Indo-Tibetan Border Police (ITBP) and Central Reserve Police Force (CRPF).
  - Security and Law Enforcement Agencies: Special Operations Units, Counter-IED Teams and VIP Protection Forces.
  - Defence R&D and Manufacturing Partners.
  - Indigenous defense manufacturers under the "Atma Nirbhar Bharat" initiative.

- **Academic Partner Name:**
  Amrita Vishwa Vidyapeetham, Coimbatore

- **Faculty Name:**
  Dr. Shantanu Bhowmik, Principal Investigator Professor: Department of Aerospace Engineering

- **Overall Cost:**
  14944800

- **Financial Benefits Realised:**
  The use of indigenous materials significantly lowers material costs by reducing dependency on imports. Additionally, the armour being 50% lighter leads to reduced transport costs, as it decreases fuel consumption and logistical expenses. This lighter design also contributes to a longer vehicle lifespan by minimizing wear and tear. The scalable design of the armour makes it suitable for mass production, which in turn lowers the per-unit cost. Furthermore, the improved protection results in fewer casualties and damages, ultimately saving costs associated with repairs and medical support.

- **TRL:** 6

- **Situation:**
  The project focuses on developing a lightweight hybrid composite designed specifically for mine blast protection in military vehicles. This initiative brings together multiple key contributors, each playing a vital role in its success. The Lead Institution spearheaded the design and development of the composite material, ensuring it meets the stringent requirements for defence applications. NAL Bangalore contributed by facilitating the autoclave processing of the composite, a critical step in achieving the desired structural integrity and performance. TBRL Chandigarh played a crucial role in conducting advanced testing and validation to ensure the material's effectiveness under real-world conditions. The Defence Forces are the end users, responsible for conducting field trials to assess the composite's performance in operational environments. Additionally, the Indian Industry supported the project by supplying indigenous materials under the Atma Nirbhar Bharat initiative, helping reduce import dependency and promote self-reliance in defence manufacturing.

- **Task and Technology Used:**
  The primary task of this collaborative project was to develop a lightweight, blast-resistant hybrid composite tailored for the protection of military vehicles. To achieve this, a combination of advanced technologies and methodologies was employed. Finite Element Analysis (FEA) simulations were used to model and predict the composite's behaviour under blast conditions, enabling optimization before physical testing. The

hybrid composite design integrated multiple materials to balance strength, weight, and durability. For realistic blast testing, the team applied the Cranz-Hopkinson scaling law, which allows for accurate simulation of mine blasts at reduced scales. The composite was also developed in compliance with STANAG 4569, a NATO standard that defines protection levels for occupants of logistic and light armoured vehicles. To validate the design, prototype testing was conducted at TBRL, ensuring the material met performance expectations under controlled yet rigorous conditions. The expected outcome of this collaboration and technology integration is a cost-effective, scalable, and field-ready armour solution that enhances the survivability of military vehicles while reducing weight, fuel consumption, and maintenance costs.

### Actions Undertaken:

The project involved a series of well-coordinated technical steps to achieve its objectives. Initially, hybrid composite structures were designed and simulated using advanced modelling tools to predict their performance under blast conditions. Based on these simulations, prototypes were fabricated to translate the designs into physical models. These prototypes then underwent rigorous blast testing at TBRL, where their resistance to mine blasts was evaluated. Following the test results, the composite structures were iteratively optimized to enhance their performance, ensuring they met the required defence standards for field deployment.

### Results/Outcome:

The project successfully developed and tested a lightweight, mine blast-proof hybrid composite first time in India that achieved approximately 50% weight reduction compared to conventional armour systems. The composite demonstrated effective blast resistance through both scaled and full-scale trials, validating its performance under realistic conditions. With these results, the system is now ready for field deployment, offering a robust, indigenous solution for enhancing the safety and operational efficiency of military vehicles.

### Impact:

This project has made a meaningful impact across multiple dimensions. Financially, it has led to significant cost savings by utilizing indigenous materials, which reduce import expenses, and by lowering the logistics burden through the use of lightweight armour, cutting down fuel and maintenance costs. From an environmental standpoint, the lightweight design and local sourcing contribute to a reduced carbon footprint, supporting sustainable defence practices. In terms of research capability, the successful development and testing of this scalable hybrid composite has strengthened national defence R&D, showcasing India's ability to innovate and deploy advanced protective technologies independently, thereby enhancing strategic autonomy and technological self-reliance.

### Describe Industry-Academia Partnership Challenges Faced During this Collaboration:

The collaboration between academic institutions and industry partners enabled advanced R&D and prototype testing by leveraging academic expertise and industrial resources. However, several challenges emerged during the process. One major hurdle was aligning project timelines, as academic research often follows a different pace compared to industry-driven schedules. Ensuring the timely availability of specialized materials also posed difficulties, particularly when relying on indigenous sources. Additionally, integrating defence-grade standards across diverse partners required continuous coordination and rigorous quality control to meet stringent compliance requirements. Despite these challenges, the partnership fostered innovation and contributed to a successful outcome.

### Key Learnings:

This project demonstrated that industry-academia synergy plays a crucial role in accelerating defence innovation by combining the deep research capabilities of academic institutions with the scalability and practical implementation strengths of industry. A key learning is that alignment in standards, timelines, and material sourcing is essential for the success of such collaborations.

# CLIMATE ETC TECHNOLOGY SERVICES PRIVATE LIMITED

## Operation Possible - Cooling Cart

**Type of partnership:**
Industry Sponsored Research Project

**Start Year of Partnership:**
2021

**Leader Name:**
Zubin Varghese

zubin.varghese@tranetechnologies.com

**Current Status:**
In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  Street Vendors
- **Academic Partner Name:**
  Cambridge Institute of Technology - CIT, Bengaluru Karnataka
- **Faculty Name:**
  Dr. D. Antony Louis Piriyakumar
- **Overall Cost:**
  2500000
- **Financial Benefits Realised:**
  Reduce food loss and double the income of street vendors
- **TRL:** 7

- **Situation:**
  Trane Technologies launched the "Operation Possible" initiative—an employee-powered innovation program targeting real-world environmental and social challenges. A key focus: reducing food waste by aiding street vendors in hot climates. The Cooling Cart was born out of this goal, addressing the alarming issue that globally ~30% of food is wasted, and vendors in places like India lose up to one-third of fresh goods due to lack of best practices. By keeping produce cool, street vendor cooling carts can help reduce the nearly 1 billion metric tons of food that gets discarded every year, much of it winding up in landfills, where the United Nations estimates it contributes 10% of global climate-warming gases as it decomposes. Keeping healthful food fresh longer is critical at a time when, according to the World Food Program, more than 800 million people are unsure where their next meal is coming from.

- **Task and Technology Used:**
  Task: Design an affordable, passive cooling cart prototype to extend the shelf life of perishable goods without electricity. Technology: Utilized radiative cooling canopy technology—a reflective, retractable, passive film canopy that dropped internal cart temperature by as much as 10 °C and acted as overnight storage.

- **Actions Undertaken:**
  1. Ideation & Design Sprint: An international team (India, China, Vietnam, Belgium, North America) built the concept focused on street vendor needs by directly engaging them for input .
  2. Prototyping: Created a prototype Cooling Cart with adjustable canopy, easy retrofitting on traditional carts, and self-contained storage.
  3. Pilot Programs: Started small pilots—15+ carts distributed across Karnataka, Maharashtra, Mangalore and even Nigeria. Vendors reported positive results.

- **Results/Outcome:**
  Development of cooling cart, doubled the income of street vendors. This cart keeps fruits and vegetables fresh for longer, reduces food waste, and doubles the street vendors' potential income—all without using electricity and at a low cost by making it a retrofitted solution. Extended shelf life: Fresh produce lasts 1–2 extra days without significant weight loss. Reduced food loss: Potential 25% reduction in marketplace spoilage. Improved earnings: Vendors, many earning less than Rs 500 /day, could sell more produce— doubling income and reducing waste . Scalability: Prototype transitioned into CSR-funded pilots, including free distribution and institutional partnerships with local MLAs and NGOs. Temperature Control : Cart temperature lowered by up to 10°C (18°F) during peak heat, helping preserve freshness without electricity. Reach and Scale - 15 Cooling Carts distributed in India (Bangalore, Mangalore, Maharashtra) and Nigeria as part of pilot testing. - Each cart supports vendors who cater to 100–150 customers per day, impacting over 1,500–2,000 people/day across all pilot locations

- **Impact:**

  Economic Impact : Doubled the income of street vendors food waste reduction - vendors reported 25–30% reduction in food spoilage, especially during hot afternoons. - Shelf life of perishable items like tomatoes and leafy vegetables extended by 1 to 2 days. Energy & Sustainability - Requires 0 units of electricity — 100% passive cooling via a radiative reflective canopy. - Retrofit design allows usage on existing carts, reducing upfront investment.

- **Describe Industry-Academia Partnership Challenges Faced During this Collaboration:**

  'Design & Usability: Balancing affordability, durability, adjustability, and weight in the canopy design for daily vendor usage. Adoption & Scaling: Ensuring vendor acceptance and usage across different regions & climates. Partnerships: Collaborating with academic institutes (e.g., Cambridge Institute of Technology) and navigating regulations with policymakers . Sustainability: Improving next-gen versions for cost-effectiveness, user-friendliness, and long-term durability.

- **Key Learnings:**

  The Cooling Cart exemplifies how a simple, cost-effective solution—sparking from an employee's idea—can translate into a real-world innovation with measurable social, economic, and environmental impact. It extended produce lifespan by 1–2 days, decreased waste by up to 25%, increased vendor income, and laid the groundwork for broader deployment through strategic collaborations. Challenges remain around durability, scale, and iteration, but the initiative demonstrates how cross-functional, ground-up innovation can deliver meaningful change.

# ACCENTURE SOLUTIONS PVT. LTD.

## Neuromorphic Computing - Smartcockpit and Smart Vision

**Type of partnership:**
Industry Sponsored Research Project

**Start Year of Partnership:**
2022

**Leader Name:**
Shubhashis Sengupta

shubhashis.sengupta@accenture.com

**Current Status:**
Completed

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  R&D teams in AI/ML, Edge AI, and compute efficiency
- **Academic Partner Name:**
  Indian Institute of Science (IISc), Bangalore
- **Faculty Name:**
  Prof Chetan - IISC Bangalore
- **Overall Cost:**
  6000000
- **Financial Benefits realised:**
  Early-stage benefits include acceleration of edge AI strategy, IP creation, and internal capability building
- **TRL:** 3

- **Situation:**
  The partnership was initiated to explore neuromorphic computing's potential in solving compute efficiency challenges for AI at the edge. Accenture defined application domains, while IISc brought in expertise on brain-inspired architectures, spiking neural networks, and chip-level simulation.
- **Task and Technology Used:**
  The project aimed to co-develop frameworks and simulation environments for spiking neural networks (SNNs), aligned with neuromorphic chip platforms. Use cases included low-power vision processing, anomaly detection, and sensory data fusion.
- **Actions Undertaken:**
  Joint research sprints and weekly sync-ups * Co-authored technical reports * Talent immersion for Accenture teams * Prototypes for select edge AI scenarios
- **Results/Outcome:**
  Foundational simulation models for SNNs * Whitepaper draft in progress * Use-case feasibility mapped for manufacturing and healthcare clients
- **Impact:**
  Strengthened Accenture's deep-tech R&D capability * Created internal awareness around neuromorphic potential * Contributed to sustainable AI strategies through energy-efficient compute research
- **Describe Industry-Academia Partnership Challenges faced during this collaboration:**
  Academic research pace was slower than industry timelines * Translating theoretical models to deployable components required sustained engagement * Limited availability of real-world datasets for neuromorphic model validation
- **Key Learnings:**
  Dedicated translational research tracks and joint IP frameworks can fast-track deployment * Government-backed testbeds for emerging tech (like neuromorphic chips) would ease experimentation * Skilling grants and industry sabbaticals for faculty can boost relevance and speed.

# GREW ENERGY

## TBD

**Type of partnership:**
Industry Sponsored Joint Research Lab for Academia

**Start Year of Partnership:**
2024

**Leader Name:**
Shri Vinay Thadani
Director and CEO
rosette.s@grew.one

**Current Status:**
In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  Renewable Industry specifically Solar segment and public at large.
- **Academic Partner Name:**
  dkabra@iitb.ac.in
- **Faculty Name:**
  Dinesh Kabra, PhD
- **Overall Cost:**
  50000
- **Financial Benefits realised:**
  Not Applicable
- **TRL:** 0

- **Situation:**
  Academia from IITB and Testing from GREW Energy
- **Task and Technology Used:**
  TOPCon technology
- **Actions Undertaken:**
  MOU signed
- **Results/Outcome:**
  In-process
- **Impact:**
  Solar module panels will be made available to Indian consumers at subsidized rates.
- **Describe Industry-Academia Partnership Challenges Faced During this Collaboration:**
  It was very well planned so no challenges.

- **Key Learnings:**
  na

# BHARAT FRITZ WERNER LTD

## Alternate Material for Improving Dynamic Response and Damping Properties of Machine Tool Structures

**Type of partnership:**
Industry Sponsored Research Project

**Start Year of Partnership:**
2020

**Leader Name:**
Mr. Ashok N Badhe
Vice President-R&D
ashokbadhe@bfw.co.in

**Current Status:**
Completed

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  This research project benefits a wide range of stakeholders across the manufacturing and technology ecosystem. Industrial machine tool manufacturers, including BFW Ltd. and other Indian OEMs producing vertical and horizontal machining centers and high-speed CNCs, gain access to epoxy granite design solutions that offer improved dynamic performance, thermal stability, and reduced weight, along with shorter development cycles through validated simulation data. Precision component manufacturers in sectors like aerospace, medical, die and mold, and optics benefit from enhanced machine stability, leading to better surface finish, dimensional accuracy, and the ability to machine challenging materials such as Inconel and titanium. R&D institutions and academia, such as PSG College of Technology and others working in machine design and materials research, gain exposure to real-world industry problems, access to valuable data, and opportunities for publications and innovation. Indian government bodies like the Department of Science and Technology (DST) and the Principal Scientific Advisor's Office also benefit through the promotion of indigenous machine tool development, supporting the "Make in India" and "Atmanirbhar Bharat" initiatives, reducing import dependency, and empowering MSMEs. Finally, design and simulation tool developers benefit from the validation of advanced modeling techniques and the potential to create specialized design modules for hybrid materials like epoxy granite.

- **Academic Partner Name:**
  PSG college of Technology, Coimbatore
- **Faculty Name:**
  Dr. P R Thyla HOD- Mechanical Department
- **Overall Cost:**
  15600000
- **Financial Benefits Realised:**
  The adoption of epoxy granite in machine tool design offers significant economic and performance advantages. By eliminating the need for traditional casting and heat treatment, manufacturers can achieve 15–20% lower structural costs compared to cast iron. The improved dimensional accuracy of epoxy granite components reduces machining requirements, minimizes rework, and shortens assembly times, leading to lower labor costs. Machines built with this material exhibit higher spindle speeds, reduced vibration, and extended tool life, resulting in a 10–15% increase in productivity. Additionally, the lighter weight of epoxy granite structures contributes to reduced logistics, handling, and foundation costs. For BFW, these improvements translate into substantial business gains, including the development of a premium product line targeted at high-end sectors such as aerospace and die/mold, enhanced export potential, and a competitive edge through proprietary technology and superior machine performance.
- **TRL:** 9

## Situation:

The project titled “Alternate Materials for Improving Dynamic Response and Damping Properties of Machine Tool Structures” is a collaborative initiative between PSG College of Technology and BFW Ltd., supported by the Department of Science and Technology (DST). The primary objective is to replace traditional cast iron structures in machine tools with epoxy granite (EG) to enhance damping, stiffness, and thermal stability. BFW Ltd. contributed by providing the VMC platform (BMV 45+), along with machine data and support for material development and implementation. PSG College of Technology led the design, finite element analysis (FEA), testing, and development of the new material. DST’s involvement through project funding aligns with its focus on indigenous innovation. The outcome of the project was the successful validation of EG-based machine columns and bases, demonstrating up to 50% improvement in damping and significantly enhanced dynamic performance, making it ideal for high-precision and high-speed machining applications.

## Task and Technology Used:

The project involved a comprehensive approach to replacing cast iron with epoxy granite (EG) in machine tool structures, beginning with benchmarking existing cast iron vertical machining center (VMC) components through static and dynamic (modal) analysis, validated using Experimental Modal Analysis (EMA). Material development focused on designing and fabricating EG composites reinforced with steel, followed by mechanical testing to refine the resin–aggregate ratio and reinforcement layout. In the design phase, Finite Element Analysis (FEA) was conducted using ANSYS Workbench to evaluate stiffness, natural frequencies, and stress distributions across multiple base and column configurations (7 base and 9 column designs). Prototype evaluation included both full-scale and scaled EG structures, which were benchmarked against their cast iron counterparts. The project utilized advanced technologies, including EG material science, FEA simulations, EMA tools like ME’Scope VES, vibration compaction tables, and high-precision testing equipment such as tri-axial accelerometers and coordinate measuring machines (CMMs). The outcome was the successful development and validation of EG-based VMC structures with 4–10 times higher damping, 10–15% improved stiffness, and 20% better thermal stability. Additionally, the project delivered a comprehensive design methodology for future EG-based machine tools, paving the way for cost-effective, vibration-resistant solutions ready for commercial adoption by BFW.

## Actions Undertaken:

The project began with problem identification and a baseline study focused on BFW’s BMV 45+ VMC, where conventional cast iron (CI) structures were found to suffer from high deflection, low damping, and thermal instability—limiting machining performance. Through static and dynamic analyses using Finite Element Analysis (FEA) and Experimental Modal Analysis (EMA), these limitations were quantified. To address them, an epoxy granite (EG) composite was developed using crushed granite, epoxy resin, and hardeners, with various particle sizes, resin ratios, and steel reinforcements tested to optimize mechanical properties such as strength, stiffness, and damping. Multiple EG base and column configurations with internal steel frames were designed and analyzed through FEA to assess static stiffness, natural frequencies, damping, and stress responses under machining loads. Scaled and full-scale EG prototypes were fabricated and subjected to EMA, allowing for direct performance comparisons with CI structures under identical conditions. The optimized design, notably Base Design-7 with L-channel reinforcement, achieved up to 56% reduction in deformation, 50% higher natural frequencies, and a 4–10× increase in damping. The team also prepared molds for both 1:1 and 1:2.25 scale components. Final deliverables included detailed design guidelines, comprehensive FEA and EMA databases, peer-reviewed publications, and validated outcomes shared with BFW for potential commercialization of EG-based machine tools.

## Results/Outcome:

The project achieved the successful development of epoxy granite (EG) base and column structures for the BMV 45+ vertical machining center (VMC), delivering substantial performance improvements over conventional cast iron. Key results include a 4–10× increase in damping, a 36–56% reduction in structural deformation indicating significantly higher stiffness, and a 12–50% rise in natural frequencies, reflecting enhanced dynamic stability. Additionally, the EG structures offered around 20% better thermal stability and were approximately 2.7 times lighter, contributing to easier handling and reduced foundation requirements. The validated EG designs are now ready for integration into commercial machines, supported by published research and comprehensive design guidelines that pave the way for broader adoption of EG in future machine tool development.

## Impact:

The project has delivered significant multi-dimensional impact across financial, environmental, research, and national domains. Financially, the adoption of epoxy granite structures enables 15–20% cost savings in machine structure manufacturing, with a projected annual gain of ₹30–50 lakhs at scale, along with a 10–15% boost in productivity driven by reduced vibration and tool wear. Environmentally, the shift away from cast iron eliminates foundry emissions, supports energy-efficient production, and results in a lower carbon footprint and reduced material waste. The lighter EG structures also reduce transportation and foundation requirements. From a research perspective, the project has enhanced PSG Tech's capabilities through infrastructure upgrades, publication of peer-reviewed papers, and the establishment of design standards and validated simulation methodologies (FEA and EMA) for future machine tool development. At the national level, the outcomes align with the goals of Atmanirbhar Bharat and Make in India, enabling the indigenous development of high-performance machine tools and showcasing a successful model of industry–academia collaboration.

## Describe Industry-Academia Partnership Challenges Faced During this Collaboration:

The collaboration between PSG College of Technology and BFW faced typical industry–academia challenges. Key issues included differing objectives and timelines, with academia focusing on research depth and industry on quick, practical outcomes. Data sharing required formal NDAs, causing initial delays. Resource limitations at PSG led to dependency on BFW for machine testing and prototype validation. Communication gaps arose due to different technical languages and expectations. Academic designs also needed industrial refinement before implementation. Despite these hurdles, regular coordination and mutual understanding helped align goals and achieve impactful results.

## Key Learnings:

Aligning academic research with industrial needs is crucial for generating impactful, real-world solutions. Establishing formal agreements—such as NDAs and IP terms—helps build trust and facilitates smoother, faster collaboration between institutions and industry partners. Regular joint reviews and the sharing of resources enhance project efficiency and foster mutual understanding, while direct industry exposure equips students with practical skills and ensures academic work remains relevant to current technological demands. Suggestions for Policymakers include fostering long-term industry–academia consortia in key strategic sectors, simplifying intellectual property and NDA procedures through standardized frameworks, and providing funding incentives or tax benefits for collaborative R&D. Additionally, mandating industrial internships within government-funded research projects can bridge the gap between theory and practice. Investing in shared infrastructure and highlighting successful partnerships as national models can further encourage widespread adoption of collaborative innovation practices.

# MAHINDRA & MAHINDRA LTD

## Industry – Academia Partnership ( Web Enabled Programs with IITM)

**Type of partnership:**
Industry Sponsored Continuing Education Program

**Start Year of Partnership:**
2023

**Leader Name:**
Dr. Shankar Venugopal

23172836@mahindra.com

**Current Status:**
In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  Product Development Engineers
- **Academic Partner Name:**
  IIT Madras
- **Faculty Name:**
  Professor Ramesh A
- **Overall Cost:**
  144 (unit missing)
- **Financial Benefits realised:**
  Not Applicable
- **TRL:** 9

- **Situation:**
  The engineers at Mahindra Research Valley are on a technical career path where many opportunities to upskill themselves are given. There is a dedicated organization – the Mahindra Technical Academy (MTA) that is focused on building technical competencies for engineers at all levels. Many of the working professionals (practicing engineers) in the company want to pursue their higher studies in premier institutions. The company also wants to promote this culture to enable the young engineers to have the culture of continuous learning and hone deeper technical skills. At the same time, the company wants the employees to work on important projects and can't afford to release them for regular master's program for a long duration like two years. Also there was shift in the Technology from ICE to EV in the automotive domain and many of our Engineers are Mechanical Engineers and we have to quickly reskill them in EV domain. This made us look at the problem from a different angle.

- **Task and Technology Used:**
  To come up with an M.Tech program, which can be delivered online and employees can attend the program without going to IITM on a daily basis which will also lead them to earn a degree.

- **Actions Undertaken:**
  IIT Madras (IITM) being a premier institute in the close vicinity of MTA, we wanted to work closely with IITM and come up with a solution for this. This lead to the solution of web-enabled M.Tech in Automotive Technology (WEMAT) wherein the employees sponsored by the company can attend the class from MTA and the Professor teaches from IITM and it is a live class. This enabled live classroom experience to students without compromising on the academic rigour. The classes were scheduled from 5 pm to 7 pm for 3 days a week so that the employees can complete their daily work and attend the class at the end of office hours. This is a win-win solution for both the company and the employee. Since the employee has to focus on both work and study, the number of subjects per semester was reduced to 2 and the course duration was extended to 3 years instead of 2 years.

- **Results/Outcome:**
  Successful launch of M.Tech program with IITM through Web enabled mode.

- **Impact:**
  This led to the successful enrollment of our engineers for the course and as of now this batch has successfully completed the course and await their M.Tech degree. Post this we have launched M.Tech in multiple domains like Electrical & Electronics, E-mobility and have enrolled Engineers in these courses. Also lined up nominations for new programs like Mechanical Design, Artificial Intelligence. Employees sponsored for this course had a longer retention period

with the company and they were able to apply effectively their technical expertise in the new projects. These trained employees developed innovative features in the new products and also created valuable intellectual property (IP). This helped us to upskill and reskill our Engineers in newer domains and this was extensively leveraged during the transition from ICE to EV.

### Describe Industry-Academia Partnership Challenges Faced During this Collaboration:

The key challenge faced was to restrict the number of nominations from interested employees, facility management especially when multiple batches were running at same time. Streamlining the payment process was also one of the challenges faced during this.

### Key Learnings:

The key learning was the enablement of online mechanism for M.Tech program which was never imagined earlier, and it was a success. The same courses could be leveraged more for the course work for PhD aspirants from Industry so that more members from Industry can enroll for PhD programs with more of practical industry relevant problems.

# ITC LIMITED

## Delivering Customized Crop Advisory via Farm Advisory Pilot Under Operation Dronagiri at Varanasi through ITCMAARS Platform

**Type of partnership:** Industry Sponsored Consulting by Faculty

**Start Year of Partnership:** 2024

**Leader Name:** Dr. Anita Sharma

Dranita.Sharma@itc.in

**Current Status:** Completed

- **Target Audience/Major Users and Beneficiaries of the Partnership:** Farmers & Farmer Producer Organizations (FPO).
- **Academic Partner Name:** Department of Science and Technology (DST).
- **Faculty Name:** Chairman of GDPDC (Geospatial Data Promotion and Development Committee) - Mr. Srikant Sastri
- **Overall Cost:** 4000000
- **Financial Benefits Realised:** 26.4% increment in net returns, 15% savings in fertilizer.
- **TRL:** 9

- **Task and Technology Used:**

Various data points like agronomic practices, location-specific soil fertility data, geo-coordinate-based weather data, hyperlocal remote sensing data, progressive farmers and govt. schemes and subsidies data were used to relay integrated hyperlocal advisory to 27,000+ farmers of Varanasi. Integrated and hyperlocal crop advisory was shared digitally through ITCMAARS App and physically by capability building programmes through experts and ground team.

- **Actions Undertaken:**

  - Total number of advisories facilitated through ITCMAARS App during rabi season 2024-25 for the pilot farmers – 189
  - Farmers reached out through telecalling, WhatsApp and IVRS Campaigns ~ 85,000
  - Customized fertilizer recommendations at FPO level through soil tests covering 15 FPOs in the geography.
  - Dissemination of real-time weather advisory – Weather forecasts and weather-based crop advisories were delivered to the project farmers by partnering with Indian Meteorological Department (IMD).
  - Videos of progressive farmers and testimonials to inspire fellow farmers in adopting advanced agricultural practices.
  - Expert videos from the scientists of Krishi Vigyan Kendra (KVK) to educate farmers on the good agricultural practices.
  - Information on government schemes, animal Husbandry and other POPs, e.g. Irrigation management, pest and disease management was disseminated.
  - AI-ML based crop advisory – instant diagnosis of the pest and disease and its integrated control measures through Crop Doctor feature. Farmer query resolution through Krishi Mitra AI Chatbot.

- **Results/Outcome:**

ITCMAARS successfully delivered customized hyperlocal crop advisory to 27,000+ farmers of 15 FPOs in 3 blocks of Varanasi catering 39,000 acres during rabi season 2024-25.

  - Fertilizer savings through customized nutrition advisory helped in optimizing the cost of cultivation, improving productivity and reducing the environmental impact.
  - Enhancement in yield and net returns of the farmers by 15% and 26%, respectively.
  - 88% farmers opined enhancement in knowledge on right crop cultivation practices.
  - 78% farmers acknowledged increase in yield and income.
  - 84% farmers confirmed positive influence of balance fertilizer usage.

### Impact:

Following are the key improvements, measured as performance in impact plots (where ITCMAARS advisory was implemented) versus control plots (continuation of traditional farming practices). Third-party assessments suggest the projected impact of the pilot is as follows:

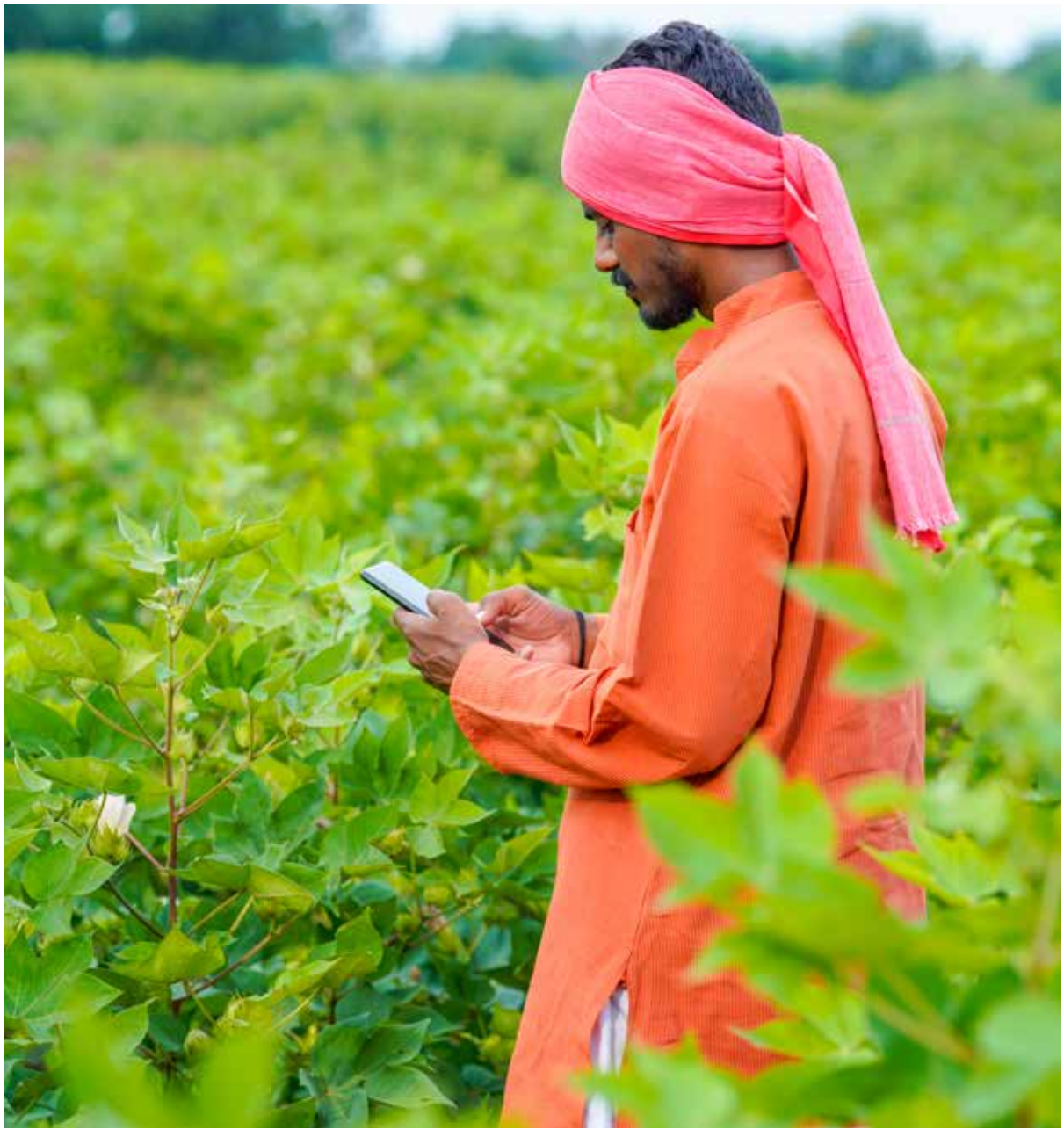
- 15.3% increase in yield
- 15% saving in chemical fertilizers
- 26.4% increase in net returns

### Describe Industry-Academia Partnership Challenges Faced During this Collaboration:

NA

### Key Learnings:

- Streamlining processes: Standardizing documentation, clear evaluation criteria, minimizing delays can help streamline the process leading to more participation from private entities.
- Facilitating right skilling -Centre of excellences should be set up with govt support.
- Funding support from the Government, if the product/ technology is being developed for public good.



# TATA CHEMICALS LIMITED

## Harnessing Microalgae: A Green Revolution in Sustainable Biofuels

**Type of partnership:** Industry Sponsored Research Project

**Start Year of Partnership:** 2023

**Leader Name:** Dr. Richard Lobo

rlobo@tatachemicals.com

**Current Status:** In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  Microalgae-based biofuels target industries seeking sustainable energy solutions. Key customers include transportation sectors (aviation, automotive, marine), power generation companies, and governments aiming to reduce carbon emissions. Additionally, industries in regions such as North America, Europe, and the Asia-Pacific are investing in renewable energy sources, presenting opportunities for the adoption of microalgae biofuel. Environmental policies and the need for alternative fuel options drive these sectors.
- **Academic Partner Name:**
  CSIR-CSMCRI
- **Faculty Name:**
  Dr. Sourish Bhattacharya
- **Overall Cost:**
  1 (unit missing)
- **Financial Benefits Realised:**
  Not applicable
- **TRL:** 6

- **Situation:**
  Microalgae have attracted significant interest as an alternative feedstock for biofuel production, to tackle climate change issues and phasing out the usage of fossil fuels. Production of biofuel from microalgae serves as a potential sustainable energy source for various applications. These photosynthetic microalgae have ability to thrive in diverse environment such as non-arable land, wastewater, and utilize solar energy and carbon dioxide to produce energy-rich compounds (i.e., lipids), that can be further converted into biofuels of different types. Tata Chemicals is interested in exploring microalgae-based solutions for biofuel production and partnered with CSIR – Central Salt and Marine Chemical Research Institute (CSIR-CSMCRI), Bhavnagar for microalgae technology. This collaboration helped in further optimizing cultivation parameters at 300 litres photo-bioreactor for enhanced biomass yield and lipid accumulation.

- **Task and Technology Used:**
  The primary task of this project is to develop and optimize a controlled cultivation system for microalgae aimed at biofuel production, with a focus on maximizing biomass and lipid yield. Following are the major tasks of the collaborative approach:
  1. Acclimatization of CSIR-CSMCRI strain at Mithapur.
  2. Cultivation in a photo-bioreactor (PBR): This is a semi-closed cultivation system that provides a controlled environment for microalgae growth using light, carbon dioxide, water, and nutrients. Compared to open pond systems, PBRs offer higher productivity, better contamination control, and more efficient resource utilization.
  3. Monitoring and optimizing growth parameters (light, nutrients, $CO_2$).
  4. Suitable solvent for non-polar lipid extraction with 95% of specific carbon chain length (C14, C16 & C18) for biofuel conversion.
  5. Testing for the suitability of algal oil for biofuel production 6. Utilization of de-oiled biomass for value-added product (biochar).

### Actions Undertaken:

Microalgae cultivation optimization at 300 litres photo-bioreactor is under progress, optimization of suitable solvent for oil extraction to achieve more than 20% oil is under progress. Trials are underway to extract oil from algal biomass and its suitability for biofuel production.

### Results/Outcome:

Developed research capability in microalgae-based biofuel production which offers a sustainable energy solution while simultaneously addressing climate change through carbon dioxide ($CO_2$) sequestration.

### Impact:

1. Successfully optimized light parameter at 10 litres PBR for microalgae growth and achieved projected biomass yield.
2. 1.4 Kg of CO2 is fixed per kg of biomass produced.
3. Approximately 95% of the extracted oil consists of C14–C18 carbon chain lengths.
4. Acclimatization and survival of CSIR-CSMCRI strain has been established at Mithapur.

### Describe Industry-Academia Partnership Challenges Faced During this Collaboration:

Despite its potential, microalgae-to-biofuel production faces several challenges that hinder large-scale commercialization. High costs associated with cultivation, harvesting, and lipid extraction make the process economically challenging with current conventional fossil-based fuels pricing.

### Key Learnings:

- Encourage structured involvement of industry stakeholders during the early stages of academic research planning.
- Promote academia-led feasibility and techno-economic studies to assess the scalability and commercial potential of emerging innovations.

# ALPLA INDIA PVT LTD

## Dual Apprenticeship Program

**Type of partnership:** Industry Sponsored CSR

**Start Year of Partnership:** 2020

**Leader Name:**
Mr. Vagish Dixit - Chief Engagement Officer, ALPLA Global & Managing Director - ALPLA India
surendra.babu@alpla.com

**Current Status:** Completed

- **Target Audience/Major Users and Beneficiaries of the Partnership:**

  Students:

  1. Positive Impact on the lives of students from economically weaker background.
  2. 100% Job Placement opportunity at ALPLA with defined career path
  3. Global exchange program for more learning and exposure

  Organization:

  1. Trained and culturally fit resources available with low hiring cost reducing the Vacancy time to fill (VTTF)
  2. Less new hire attrition % compared to the lateral hirings

  Education System:

  1. Change in Institutes and Faculty mindset to adapt to the changing world
  2. Understanding industry requirement and provide tailor-made courses
  3. Overall development and grooming of students in collaboration with Industry experts
  4. 100% placement opportunity and better visibility for colleges

- **Academic Partner Name:**
  NA

- **Faculty Name:**
  NA

- **Overall Cost:**
  10000000

- **Financial Benefits realised:**
  Not Applicable

- **TRL:** NA

- **Actions Undertaken:**
  The shortage of skilled resources is a serious issue that many companies face all around the world. ALPLA was no different at a point in time, it was difficult for us to get candidates in the niche technologies that we operate on. The repercussion of this on business was nothing less than reduced production, increased cost, both direct and indirect. Further, few of our technologies are prominent in overseas and as such the attrition was high due to International or overseas Job opportunities. The demand was high and supply was less. This skill gap and unavailability of resources at the right time made ALPLA to think innovatively to bridge the gap not only for the skilled resources but also to curb the time taken to fill the vacancy.

- **Results/Outcome:**
  NA

- **Impact:**
  NA

- **Key Learnings:**
  NA

# CUMMINS TECHNOLOGIES INDIA PRIVATE LIMITED

## Droplet Wall Interaction Dynamics During Urea Dosing in an After Treatment System

**Type of partnership:** Industry Sponsored Research Project

**Start Year of Partnership:** 2023

**Leader Name:** Ambarish D Khot

ambarish.d.khot@cummins.com

**Current Status:** Completed

- **Target Audience/Major Users and Beneficiaries of the Partnership:** Cummins Emissions Solutions worldwide
- **Academic Partner Name:** IIT Dharwad
- **Faculty Name:** Dr. Hiranya Deka
- **Overall Cost:** 336000
- **Financial Benefits Realised:** Not applicable
- **TRL:** 4

- **Situation:**

Cummins Emission Solutions initially used a qualitative method to predict urea deposits in the Selective Catalytic Reduction (SCR) system, part of the diesel engine aftertreatment process. This approach required extensive and costly testing in both test cells and actual vehicles, adding development complexity. Improper handling of deposits could lead to reliability issues and customer escalations. To mitigate these risks, Cummins began exploring a quantitative model to estimate urea deposits and their locations early in the design phase, aiming to improve reliability and reduce testing efforts.

- **Task and Technology Used:**

Simulation and Modeling • Computational techniques were employed to simulate the behavior of urea deposits under various operating conditions, enabling early-stage analysis and design optimization. 2. Experimental Validation • High-Speed Camera Experimentation: Used to capture real-time droplet behavior and impingement dynamics with high temporal resolution. • Bench Testing at IIT Dharwad: Conducted controlled experiments to validate simulation results and study deposit formation under realistic conditions. 3. Specialized Equipment Integration • Precision Electric Heater: Enabled accurate control of surface temperature at the point of droplet impingement, critical for replicating exhaust system conditions. • Uniform Droplet Generator: Provided by IIT Dharwad, this device ensured consistent droplet size and distribution for repeatable testing. 4. Collaborative Setup Development • A unique experimental setup was developed by combining advanced equipment from both industry and academia, facilitating comprehensive study of urea deposit phenomena.

- **Actions Undertaken:**

Simulation and Modeling • Computational techniques were employed to simulate the behavior of urea deposits under various operating conditions, enabling early-stage analysis and design optimization. 2. Experimental Validation • High-Speed Camera Experimentation: Used to capture real-time droplet behavior and impingement dynamics with high temporal resolution. • Bench Testing at IIT Dharwad: Conducted controlled experiments to validate simulation results and study deposit formation under realistic conditions. 3. Specialized Equipment Integration • Precision Electric Heater: Enabled accurate control of surface temperature at the point of droplet impingement, critical for replicating exhaust

system conditions. • Uniform Droplet Generator: Provided by IIT Dharwad, this device ensured consistent droplet size and distribution for repeatable testing. 4. Collaborative Setup Development • A unique experimental setup was developed by combining advanced equipment from both industry and academia, facilitating comprehensive study of urea deposit phenomena.

### Results/Outcome:

A modified spray-wall interaction model was successfully developed for Cummins, enhancing the accuracy of urea deposit predictions. 2. A new operational regime was identified, characterized by accelerated urea deposit growth, offering critical insights for system design. 3. A mathematical formulation of the modified spray-wall interaction model was created and implemented in a commercial simulation software, enabling data-driven design development for Cummins Emission Solutions (CES) commercial mixers. 4. As a result of the successful outcomes, a follow-up project has been awarded to IIT Dharwad, marking the continuation and expansion of this collaborative research effort.

### Impact:

Financial Impact: The improved accuracy in urea deposit estimation is projected to reduce Test Cell testing iterations by approximately 50%, resulting in significant cost savings. 2. Environmental Impact: A 50% reduction in testing also contributes to a measurable decrease in greenhouse gas (GHG) emissions associated with the testing process. 3. Technical Advancement: A robust capability for the quantitative estimation of urea deposits in the SCR system has been successfully developed and validated. 4. Talent Development: The intern who contributed to this project has been offered and accepted a position at Cummins, reflecting the project's value in fostering skilled talent. 5. Scholarly Contribution: A research paper based on this work is scheduled for publication in the Journal of Engines in August 2025.

### Describe Industry-Academia Partnership Challenges faced during this collaboration:

Defining a SMART Problem Statement: Establishing a well-scoped, Specific, Measurable, Achievable, Relevant, and Time-bound (SMART) problem statement required multiple rounds of discussion and alignment between IIT Dharwad and Cummins Emission Solutions, India. 2. Project Scoping and Timeline Alignment: Aligning the project scope with industry timelines posed a challenge, as academic institutions often operate with different priorities and pacing. Significant effort was invested to ensure deliverables met industrial expectations. 3. Laboratory Equipment Limitations: Some critical lab equipment initially faced operational issues. Coordinating with vendors for troubleshooting and resolution introduced delays in the experimental phase. 4. Unexpected Experimental Outcomes: Early experimental results deviated from expectations, necessitating collaborative review sessions with cross-functional experts from both Cummins and the university to realign the approach and refine the methodology.

### Key Learnings:

Prior planning is critical to define the problem statement, assess faculty expertise, lab capabilities, and prior industry collaboration. 2. Early alignment on NDAs and PO terms helps avoid delays during project execution. 3. A joint NDA should cover confidentiality and indemnity to build industry trust in academic partnerships. 4. Clear protocols for data security, equipment handling, and personnel safety are essential during experimentation. 5. University commitment to provide support staff—students, researchers, and technicians—is necessary to meet project needs.

# PEARSON INDIA EDUCATION SERVICES PVT. LTD

## Partnership between Pearson and Naan Mudhalvan through Pearson MePro

**Type of partnership:**
Industry Sponsored Technology Training Programme by Faculty for Skilling

**Start Year of Partnership:**
2024

**Leader Name:**
Vinay Kumar Swamy

manisha.jaya@pearson.com

**Current Status:**
Completed

- **Target Audience/Major users and Beneficiaries of the Partnership:**
  100K learners across multiple districts of Tamil Nadu, from ~280 colleges combined from Engineering and Arts and Science discipline. Additionally ~ 400 faculty through the faculty development program
- **Academic Partner Name:**
  Naan Mudhalvan
- **Faculty Name:**
  Kiran Prakash and Mariam B
- **Overall Cost:**
  100 (Currency missing)
- **Financial Benefits Realised:**
  1,00,00,000
- **TRL:** 9

- **Situation:**
  The Naan Mudhalvan program, spearheaded by the Government of Tamil Nadu, is an initiative designed to empower the state's youth. This program focuses on delivering industry-relevant skill development training, enhancing employability, and addressing the growing demand for skilled professionals across diverse industries. To date, the program has trained over 2.3 million students across more than 2,200 institutions and offers a diverse portfolio of over 250 courses in collaboration with more than 80 organizations. Pearson's Collaboration with the Naan Mudhalvan Program Pearson brings its global expertise in education technology and learning solutions to the Naan Mudhalvan program, particularly through MePro. MePro has been designated as a mandatory course for first-year learners in Engineering and Arts and Science streams. In the current academic year, MePro is catering to 1 lakh learners, underscoring its significant role in the program's implementation.
- **Task and Technology Used:**
  Pearson MePro - English language learning platform developed by Pearson
- **Actions Undertaken:**
  LMS integrated solution made available to 100K learners across multiple districts of Tamilnadu covering a total of ~280 institutions for Engineering and Arts and Science disciplines combined. - Periodic monitoring of the progress of students and adequate support provided to the faculty for better utilization of the platform. 1 week FDP organized for around 400 faculty to foster better deployment and utilization of the MePro platform. Periodic communication with all the necessary guide and help documentation.
- **Results/Outcome:**
  Program started with the conduction of pre-diagnostic test to understand their current English proficiency. Almost 100% of the learners were successfully evaluated to receive 1 level upgradation against the CEFR level. Around 10% students successfully reached the highest level of proficiency through the program.
- **Impact:**
  About 1 lakh learners better prepared for the job market and revenue of INR 1Cr to the organization.

**Describe Industry-Academia Partnership Challenges Faced During this Collaboration:**

Atleast 70% undergraduates landed on level 1 , <A1 level as per CEFR. That establishes the dire need for this course for job-readiness Experiential and personalized learning. Since different learners had different levels to start with which was detected through the diagnostic test, the communications had to be be drafted to enourage them to complete all the sections of LSRWGV  differently.

**Key Learnings:**

Not Applicable

# CONTINENTAL AUTOMOTIVE COMPONENTS INDIA PVT. LTD - TECHNICAL CENTRE

## Advanced Learning on Cybersecurity

**Type of partnership:**
Industry Sponsored Continuing Education Programme

**Start Year of Partnership:**
2023

**Leader Name:**
Kavitha P S

shinuabhi@reva.edu.in

**Current Status:**
Completed

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  Around 24 ( Experts and Architects ) of continental were batched together to attend the Advanced Learning on Cybersecurity.
- **Academic Partner Name:**
  REVA University
- **Faculty Name:**
  Dr. Shinu Abhi
- **Overall Cost:**
  2300000
- **Financial Benefits Realised:**
  Yes
- **TRL:** 9

- **Situation:**
  Looking into future needs of Cybersecurity in Automotive products and history of cyber attacks, parties involved in designing course: Cybersecurity Architects - experts - Business leads - university professors - Uniconn team of Continental.
- **Actions Undertaken:**
  Course was designed by committee of experts of continental - Business leads and Professors from REVA, which included 110 hours of course with 11 MCQs, three lab Exams, 1 group Presentation.
- **Results/Outcome:**
  Experts were able to again hands-on and expertise on threat modelling, Penetration testing, ethical hacking, threat intelligence, cloud security. With knowledge gained Continental Cybersecurity CoE was able to build multiple internal trainers and internal training content. from 2023 to till today around 100 cybersecurity engineers internally are trained.
- **Impact:**
  Yes
- **Describe Industry-Academia Partnership Challenges Faced During this Collaboration:**
  Multiple alignments were done to give best composition of course content with hands-on exercises.
- **Key Learnings:**
  Establish co-located spaces where academia and industry can work together on R&D. Create secure and ethical frameworks for sharing industrial data with academic researchers. Develop long-term R&D roadmaps for key sectors.

# LAM RESEARCH (INDIA) PRIVATE LIMITED

## LAM Research India-IISc Training Program on SEMulator 3D

**Type of partnership:**
Industry Sponsored Technology Training Program by Faculty for Skilling

**Start Year of Partnership:**
2024

**Leader Name:**
Rangesh Raghavan

rangesh.raghavan@lamresearch.com

**Current Status:**
In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  So far Faculty (60) from 60 Universities/ Institutes and 2800 Engineering Students. Long term target - 190 institutes and 60,000 Engineering Students.
- **Academic Partner Name:**
  Indian Institute of Science, Bangalore
- **Faculty Name:**
  Prof. Sushobhan Avasthi
- **Overall Cost:**
  137960000
- **Financial Benefits Realised:**
  13.796 (unit missing)
- **TRL:** 4

- **Situation:**
  137960000 in cash by MeitY and $56 million in kind support from Lam Research. IISc Bangalore, through its Centre for Nano Science and Engineering (CeNSE), in collaboration with Lam Research India, successfully conducted a structured training programme aimed at strengthening semiconductor education using the industry-standard SEMulator3D platform. As part of this initiative, IISc trained selected faculty members from various academic institutions across India on semiconductor fundamentals and nanoscience. These faculty were instrumental in launching semiconductor-focused courses in their respective institutes. IISc also vetted the course curriculum, ensuring academic rigor and industry relevance, and supported the assessment of students enrolled in these programs. To further enhance practical exposure, IISc invited top-performing students to its campus for hands-on training sessions, providing them with direct experience in semiconductor fabrication and characterization. Lam Research India played a critical role in this programme by providing access to SEMulator3D, a powerful virtual semiconductor fabrication platform. They also conducted dedicated simulator-based training sessions for the student and Faculty cohort. Additionally, Lam Research actively contributed by creating awareness within academia and industry, and by facilitating employability pathways for trained students through its industry network. This joint effort by IISc and Lam Research served as a significant step toward building semiconductor readiness in the country by integrating high-quality virtual and hands-on training, aligned with the goals of the India Semiconductor Mission (ISM).

- **Task and Technology Used:**
  Lam is donating approximately $56 million or 3200 SEMulator 3D software ( a simulated manufacturing enviornment) licenses over the next two years to enable 3200 students, IISc will “Train-the-Trainers” at the selected universities.

- **Actions Undertaken:**
  Identified and shortlisted faculty members from academic institutions across India for the training programme. Conducted faculty training sessions at IISc Bangalore, focusing on semiconductor fundamentals and SEMulator3D usage. Lam Research India provided licenses access and technical training content for SEMulator3D simulation tools. Supported partner institutes in launching credit-based semiconductor courses and integrating SEMulator3D

into their curriculum. Assessed student performance through institutional evaluations and IISc-led reviews to identify top performers. Invited high-performing students to IISc for advanced hands-on training in semiconductor fabrication and characterization. Facilitated online SEMulator3D workshops and industry exposure sessions with support from Lam Research experts. Continuous support to address technical queries through Lam expert engineers. Continuous operations support by Lam Research and IISc program team for legal documentation required to onboard this program. Issued certificates to faculty and students upon successful completion of training components. Documented outcomes and best practices to ensure future scaling of the programme nationally.

- **Results/Outcome:**

  Faculty Trained: Over 60 faculty members from engineering institutes across India were successfully trained in semiconductor fundamentals and SEMulator3D based instruction (insert exact number if available). Curriculum Deployed: Institutions launched credit-based semiconductor courses, incorporating SEMulator3D for lab simulations and project-based learning. Students Benefited: A cohort of high-performing students received both hands-on training at IISc and virtual simulator training, significantly enhancing their practical understanding and job readiness. Industry-Academia Engagement: Strengthened collaboration between academia and industry, with Lam Research supporting both technology access and employability awareness. Model for National Scaling: The programme established a successful pilot model for large-scale semiconductor skill development, aligned with the goals of the India Semiconductor Mission (ISM).

- **Impact:**

  National Talent Development: Strengthened India's semiconductor ecosystem by building a skilled talent pipeline, reducing dependence on international training and accelerating the goals of the India Semiconductor Mission (ISM). Cost-Effective Training: Enabled high-impact, simulation-based training using SEMulator3D, significantly reducing the financial burden of physical cleanroom training infrastructure at scale. Academic Capacity Building: Enhanced institutional capability to deliver advanced semiconductor education, fostering self-sustained academic programs aligned with industry requirements. Environmental Benefit: Promoted virtual fabrication practices, minimizing the need for physical wafer processing and thereby reducing resource consumption and lab-related environmental impact. Research Enablement: Provided faculty and students with access to world-class simulation tools, elevating the quality of semiconductor research and design innovation at the academic level. Industry-Academia Linkages: Strengthened collaboration between industry and academia, leading to curriculum relevance, research collaborations, and improved employability outcomes. Scalability for Nationwide Reach: Demonstrated a scalable model for semiconductor skilling that can be extended to thousands of institutions across the country with minimal infrastructure costs.

- **Describe Industry-Academia Partnership Challenges Faced During this Collaboration:**

  Bridging the gap between academic course structures and fast-evolving industry standards required iterative discussions and revisions to ensure relevance and applicability. Some academic institutions faced delays in adopting SEMulator3D due to limitations in hardware, software infrastructure, or faculty familiarity with simulation tools. Introducing new, credit-based courses required internal approvals, which often involved lengthy administrative processes at various academic institutions. Ensuring consistent quality of training across faculty from diverse institutions and backgrounds was a logistical and pedagogical challenge. Faculty and students in certain regions lacked exposure to the semiconductor industry landscape, necessitating additional orientation on sectoral trends and career opportunities. Managing coordination between IISc, Lam Research, partner institutions, and students across different states and timelines required robust communication and follow-up mechanisms.

**Key Learnings:**

Course design: This course is designed through Industry and academia collaboration which ensures that the curriculum includes current tools, technologies and use cases. Students learn skills that companies need while reducing the skill gap. Students completed this course are more attractive to recruiters since they have job-relevant skills. Training model: As per program training model, IISc trains the professors from the selected institutes through "Train the Trainer" program in a month long workshop ( 2 weeks in-person in CeNSE Lab + 2 Weeks online providing SEMulator3D software demonstration) and then trained professors launches the course in their respective institutes to train the engineering students from different engineering departments. This model ensures the easy scale up of this program across nation-wide Engineering Institutes. Virtual platform: Lam Research's Semiverse® Solutions software SEMulator3D® is a simulated semiconductor manufacturing environment which is a virtual platform. This Software can be deployed easily to the institutes who has completed the onboarding process set by Lamresearch. These easy licenses deployment has eased to scale-up the program by on boarding more and more institutes year by year.

# DCM SHRIRAM LTD

## A Greener Route to Dimethyl Carbonate: Harnessing $CO_2$ and Bio-Based Epichlorohydrin as a Safer Alternative

**Type of partnership:** Industry Sponsored Research Project

**Start Year of Partnership:** 2025

**Leader Name:** Dr. Debabrata Rautaray and Dr. S Mangaleswaran

debabratarautaray@dcmshriram.com

**Current Status:** In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  The key beneficiaries of this green synthesis partnership between DCM Shriram Ltd. and the Institute of Chemical Technology (ICT), Mumbai, include:
  1) Pharmaceutical and Agrochemical Industries: Major users of Dimethyl Carbonate (DMC) as a solvent and intermediate in safe, high-purity formulations.
  2) Battery and Electronics Manufacturers: Particularly lithium-ion battery producers who require eco-friendly electrolytes and solvents.
  3) Polycarbonate and Polymer Industry: DMC is a critical feedstock in polycarbonate manufacturing, where safer and greener alternatives are in high demand.
  4) Coating and Paint Industries: DMC is a preferred low-toxicity solvent for sustainable coatings.
- **Academic Partner Name:**
  Institute of Chemical Technology Mumbai
- **Faculty Name:**
  Prof. Bhalchandra Bhanage
- **Overall Cost:**
  4500000
- **Financial Benefits realised:**
  In progress
- **TRL:** 4

- **Situation:**
  DCM Shriram Ltd., in collaboration with the Institute of Chemical Technology Mumbai, is developing a green synthesis route for Dimethyl Carbonate (DMC) using $CO_2$ and glycerol-derived epichlorohydrin. While ICT leads catalyst and process innovation, DCM Shriram leverages its ECH platform to enable sustainable solvent production for diverse industries.
- **Task and Technology Used:**
  Development of a novel catalytic process to convert $CO_2$ and bio-based ECH into DMC, enabling a greener, safer alternative to conventional toxic synthesis routes.
- **Actions Undertaken:**
  Project is underway and initial results are promising.
- **Results/Outcome:**
  The project aims to establish the first-of-its-kind green route for Dimethyl Carbonate (DMC) production using $CO_2$ and bio-based ECH, offering a sustainable, non-toxic alternative to conventional methods and contributing to greenhouse gas utilization and cleaner solvent supply for high-impact industries.
- **Impact:**
  This project will reduce reliance on hazardous raw materials, lower carbon footprint by utilizing $CO_2$, and enhance national green chemistry leadership. For DCM Shriram, it opens revenue streams from sustainable solvents and strengthens its bio-ECH value chain. It also builds advanced catalytic research capability through academia-industry collaboration with ICT Mumbai.

### Describe Industry-Academia Partnership Challenges Faced During this Collaboration:

One major challenge was the differing timelines—industry expected quicker development for commercialization, while academia required more time for in-depth research. Aligning these expectations required mutual understanding. A mid-ground was achieved by jointly agreeing to invest in critical infrastructure like high-pressure reactors and hiring dedicated personnel to work closely with the industry partner. This ensured effective collaboration, faster execution, and regular technical exchange while preserving scientific rigor and industrial relevance.

### Key Learnings:

1) Aligned Expectations: Balance industry's speed with academia's research depth through clearly defined milestones.
2) Flexible IP and Funding Models: Streamline IP policies to help industry effectively utilize developed technologies.
3) Outcome-Oriented Research: Encourage academia to pursue translational research with clear industrial relevance.

# ITC LIMITED (FOOD DIVISION)

## Climate Modelling and Risk Assessment – Advance Weather Forecasting Model for Ensuring Salt Business Continuum

**Type of partnership:** Industry Sponsored Research Project

**Start Year of Partnership:** 2024

**Leader Name:** Martin Jojo

NA

**Current Status:** In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:** Salt Business of ITC's Foods Division
- **Academic Partner Name:** IIT Kanpur
- **Faculty Name:** Dr. Anikesh Pal, Associate Professor, Department of Mechanical Engineering
- **Overall Cost:** 2500000(unit)
- **Financial Benefits Realised:** 3000000
- **TRL:** 5

- **Situation:**

Mr. Sanjiv Puri, Chairman & Managing Director of ITC Limited, emphasized the critical role of industry-academia collaboration in India's progress, particularly in driving innovation and fostering a "Viksit Bharat". ITC's thought leadership in solving business problems and partnering with academia led to the genesis of the project - "Advance weather forecasting model for ensuring salt business continuum". Early warnings help in managing the impact of climate changes to the business. This project would result in developing a system that predicts weather events in advance at plants/ RM sourcing locations. It is aimed at devising a playbook for forecasting adverse weather impacts – cyclone, flood, heat, flash rains to proactively action measures towards business continuity (facility safety and key RM securitisation) & help neighbouring communities prepare for extreme events in the longer term.

- **Task and Technology Used:**

This model has been made basis last 15 years' data on the initial conditions in Coastal and Regional Ocean Community (CROCO) model. CROCO solves the governing non-linear PDEs and provides the forecast of the wind speed, precipitation, surface air temperature, and salinity. The output parameters are utilized to estimate the rain, and extreme events, such as cyclones.

- **Actions Undertaken:**

The model has been built for Tuticorin and Gandhidham cluster and currently has the capability to forecast 500m/500m resolution for 15 days forecasting. The automation model is undergoing improvements for extending accurate predictions up to 21-30 days.

- **Results/Outcome:**

The team has demonstrated the project's feasibility and accuracy by running the model and simulating the frequency of rain and extreme weather events for the past three months with a >90% success rate.

- **Impact:**

An early prediction of extreme events will allow proactive planning to ensure supplies and business continuum, and also help neighboring communities prepare for such extreme events in advance.

- **Describe Industry-Academia Partnership Challenges Faced During this Collaboration:**

None

- **Key Learnings:**

As demonstrated, this is close to a TRL 5 product that can predict future ocean dynamics in the Bay of Bengal, Arabian Sea, and the Indian Ocean. Similar models could be developed to predict the street-wise heat waves, precipitation relevant for preventing the different crops from damage owing to extreme heat and rain. The policymakers should fund such initiatives.

# INDIAN INSTITUTE OF TECHNOLOGY MADRAS

## Futuristic Data Driven AI Companion to Material Formulation for Brakes

**Type of partnership:**
Industry Sponsored Research Project

**Start Year of Partnership:**
2023

**Leader Name:**
Dr. Janarthanan, Sundaram Brake Linings Limited

palramu@iitm.ac.in

**Current Status:**
In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  Sundaram Brake Linings Limited (SBL)
- **Academic Partner Name:**
  IIT Madras
- **Faculty Name:**
  Prof Palaniappan Ramu
- **Overall Cost:**
  8900000
- **Financial Benefits Realised:**
  8900000
- **TRL:** 7

- **Situation:**
  Data on material formulation over 30 years is available with the industry partner. This work attempts to build an AI model that can predict formulations given functional requirements and predict functional quantities, given the formulation. Such an AI model leads to cost benefits in terms of getting rid of physical experiments and also permit knowledge management at institutional level than at an individual level.

- **Task and Technology Used:**
  The expected outcome is a virtual machine type of software with a user friendly front end which permit the user to select the different variants for which the predictions are required. Under the hood, the software consists of an ensemble of machine learning models solving complex relationships and understanding the patterns in the mixed variable data towards making predictions for new formulations that are likely to give phenomenal performance.

- **Actions Undertaken:**
  Digitization of the data, structuring of the attributes for data collection, data exploration for preprocessing, graph based methods for understanding underlying data relationships and corroborating that with the legacy information at the industry partner. In addition, building machine learning models to capture the complex relationships towards decision making. Training and choosing models that will yield good performance metrics.

- **Results/Outcome:**
  Unseen formulations for new requirements

- **Impact:**
  Such a digital capability at the industry partner allows them save the time and cost on sample preparation and associated testing. This also saves material and hence friendly to the environment.

### Describe Industry-Academia Partnership Challenges Faced During this Collaboration:

Digitizing the available data was a challenge. Also since domain knowledge cannot be replaced, multiple meetings than what we foresaw was required to understand initial data grouping and how to structure the algorithms. They had to mask the attribute names and going back and forth on the real and the artificial names was a challenge.

### Key Learnings:

Firstly SBL was willing to take the risk of relatively large investment for a development that did not guarantee a product at the first place. They valued the experience of going through this project. In this case, the high risk will give them a high reward. They trusted the academic partner and worked with them to allow structuring their legacy data. They were clear on their requirements at different points  this was super important. They also had time and patience for frequent visits and have focussed discussions.

# INDIAN INSTITUTE OF TECHNOLOGY KANPUR

## Soil Nutrient Sensing Device and Method Thereof

**Type of partnership:**
Industry Sponsored Consulting by Faculty

**Start Year of Partnership:**
2024

**Leader Name:**
Mr. Rajat Vardhan,
Founder ScaNxt Scientific Technologies Pvt. Ltd.
rajat@scanxt.com

**Current Status:**
Completed

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  The collaboration between Prof. Jayant K. Singh from the Department of Chemical Engineering at IIT Kanpur and Mr. Rajat Vardhan, the founder of ScaNxt Scientific Technologies Pvt. Ltd., aimed to develop an innovative and user-friendly device for farmers in our country. This device is designed to save time and facilitate early interventions to improve soil quality, ultimately enhancing crop yield.
- **Academic Partner Name:**
  Indian Institute of Technology Kanpur
- **Faculty Name:**
  Prof. Jayant Kumar Singh (ChE)
- **Overall Cost:**
  90000(unit)
- **Financial Benefits Realised:**
  Upfront amount as licensing consideration and Royalty.
- **TRL:** 9

- **Situation:**
  The parties involved in this translation were IIT Kanpur as the licensor & developer of the technology and representatives of ScaNxt Scientific Technologies as the licensee. The device was developed in the lab facilities of the Institute, having readiness level 4 i.e. the prototype stage, which was further demonstrated on various platforms to seek interest from the industry for commercialization. As ScaNxt was already doing business in the agriculture domain, the company was intrigued and ready to launch the product. The technology transfer office of the Institute facilitated a communication structure between the parties and established legal framework in the form of agreements managing IP ownership, its usage and licensing terms. Further, handholding support was given to design the soil testing device, making it perfect for the customer to use as a final product.
- **Task and Technology Used:**
  The collaboration yielded in to the involvement of the industry to customise the lab developed product as per the company's need taking account of the innovation, valuation and uniqueness of the product. With further alteration this led to a portable soil testing device – Bhu-Parikshak.
- **Actions Undertaken:**
  Addressing the major lag in the Indian agricultural ecosystem, wherein a farmer has to wait up to a fortnight for getting the soil health cards from distant district soil testing laboratories, which takes a considerable workforce and time, this technology has been developed to test the major soil nutrients within 90 seconds.
- **Results/Outcome:**
  The rapid soil testing device named "Bhu-Parikshak" can test up to 1 Lakh soil test samples, which is the highest testing capability of a soil testing device among its predecessors. The portable and wireless soil testing device requires 5 grams of dry soil sample to detect macronutrients present in the soil. The soil sample is introduced into the 5 cm long cylindrical shaped device connected with a smartphone through Bluetooth. Once initiated, it starts analyzing the sample for 90 seconds. After the analysis, the results appear on the screen. The technology has resulted in benefiting More than 1000 orders have been placed for the

device and it has already benefitted more than 7 lakh farmers. The technology has been backed up by several state governments to help the farmers, along with multiple collaborations with industry partners and manufacturers to provide benefits to Farmers across the country, aiming to create a real-time soil health data bank of every land pocket in India.

### Impact:

The environmentally friendly device is envisaged to control the usage of fertilizer and enhance productivity leading to a significant impact on the lifestyle and health of the farmer community. The device can detect six important soil parameters viz., Nitrogen, Phosphorus, Potassium, Organic Carbon, Clay contents, and Cation Exchange Capacity. It recommends the required dose of fertilizers for the field & crops, the mobile application through the user interface. Bhu Parikshak which is available on Google play store that shows results in various local languages.

### Describe Industry-Academia Partnership Challenges Faced During this Collaboration:

During this tech transfer, the prototype developed at lab scale differed from the commercialized product. According to the field applicability, there were several changes in design before the product launch, differing the goals and exceeding anticipated timelines. The vision-benefiting the farmers of the country, being a common factor in this collaboration, industry and academia collaboratively, with inventor's handholding support, made Bhu Parikshak a success story.

### Key Learnings:

1) Co-creation of Ideas: Embrace a range of collaboration opportunities and engage early to align objectives and co-create ideas effectively.
2) Clearly define the objectives of the collaboration, ensuring alignment between academic research goals and industry needs.
3) Negotiate compromises and ensure that both parties have the necessary financial resources to support the project.

# INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

## Support for the Establishment of Research and Experiential Learning Centre on Sustainable Energy and Circularity

**Type of partnership:**
Industry Sponsored Research Project

**Start Year of Partnership:**
2023

**Leader Name:**
V Jayanarayanan

jayanarayan@ntpc.co.in

**Current Status:**
In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  The project will offer training programs based on the guidelines of IIT Roorkee's Continuing Education Centre (CEC) to help students and working professionals learn the latest technologies and job-related skills. It will also raise awareness and encourage eco-friendly practices among nearby engineering colleges, ITIs, small businesses, and organizations working for social good.

- **Academic Partner Name:**
  IIT Roorkee

- **Faculty Name:**
  Prof. Andallib Tariq, Department of Mechanical and Industrial Engineering

- **Overall Cost:**
  899999998

- **Financial Benefits Realised:**
  Research labs: Focuses on establishing research labs, sustainability living laboratories at IIT Roorkee. Experiential learning labs: Focuses on learning infrastructure for energy, ESG and other related core areas around which academic programs courses could be established, as per the CEC guidelines of IIT Roorkee. Research and Experiential Learning professionals human resource cost and travel: Details costs for project CEOs, chief laboratory officers, research staff, and administrative support as per IIT Roorkee norms. Curriculum Development & Industry Networking: Covers curriculum development, faculty training, and student immersion programs. Experiential Outreach and Monitoring and Evaluation: Involves outreach activities, seminars, and conferences, costs for creating progress reports and assessments of outcomes.

- **TRL:** 7

- **Situation:**
  The Project involves NTPC giving financial support to IIT Roorkee to set up a Research and Experiential Learning Centre focused on Sustainable Energy and Circularity. The centre will be developed and managed by IIT Roorkee.

- **Task and Technology Used:**
  The aim is to bring together universities, industries, and the government to work together, encouraging new ideas and helping people gain the skills they need to work in the sustainable energy and circular economy fields. The project focuses on improving infrastructure and supporting research in key areas, such as using waste heat to produce energy, turning waste into energy, and developing clean fuels like green hydrogen. This will help create better technology, share knowledge, and train a skilled workforce for a cleaner and more sustainable future.

- **Actions Undertaken:**
  In-Progress

- **Results/Outcome:**
  In-Progress

### Impact:

The impact of this project on the nation and the involved organizations could be quite significant in several ways Financially: It can help reduce energy costs through efficient technologies like waste heat recovery and waste-to-energy, while also opening up new income opportunities through clean energy innovations. Environmentally: It will lower carbon emissions, improve waste management, and support India's climate goals. In research and skills: It will boost innovation, strengthen collaboration between academia and industry, and help develop a skilled workforce in sustainable energy and circular practices. By connecting academia, industry, and government, the project fosters a culture of innovation and accelerates the development of practical, scalable solutions.

### Describe Industry-Academia Partnership Challenges Faced During this Collaboration:

In-Progress

### Key Learnings:

In-Progress

# INDIAN INSTITUTE OF TECHNOLOGY JODHPUR

## 2D-3D Heterostructure Based Green Catalyst for the Efficient Capture and Conversion of $CO_2$ into Green Fuel via Artificial Photosynthesis

**Type of partnership:**
Industry Sponsored Research Project

**Start Year of Partnership:**
2024

**Leader Name:**
Oil India Limited (Mrs. Ibha Kalita, Chief General Manager -R&D)
kumud@iitj.ac.in

**Current Status:**
In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:**

Oil and gas companies (including the OIL): Transitioning to sustainable fuel production and reducing their carbon footprint through $CO_2$ valorization.

Green hydrogen and synthetic fuel producers: Adopting innovative technologies to produce methanol, ethanol, or other C1 C2 fuels from waste $CO_2$.

Refineries and fuel blending units: Integrating green fuels with conventional fuels to meet regulatory standards.

Environmental and Climate Agencies

Government environmental bodies: For carbon mitigation, emissions tracking, and climate strategy implementation.

Carbon credit/trading platforms: Utilizing validated $CO_2$ conversion data for legalize carbon offsets.

Industrial and Manufacturing Sectors

Chemical manufacturing units: For sourcing sustainable precursors (methanol, syngas) derived from $CO_2$.

Steel, cement, and other industries: Benefiting from on-site $CO_2$ capture and conversion to reduce net $CO_2$ emissions.

Energy Storage and Renewable Sectors

Battery and fuel cell industries: Utilizing green synthesized graphene aerogels for energy storage applications.

Grid management authorities: Managing renewable energy surplus by converting it into storable fuel via artificial photosynthesis.

Research, Academia, and Innovation Hubs

Academic institutes and research laboratories: Adopt, learn and further tune the 2D-3D heterostructure catalyst for further materials development and innovation in environment, water remediation and energy applications.

Startups in cleantech and carbon utilization: Translating lab-scale technologies into scalable industrial solutions.

Policy Makers and Think Tanks

Energy policy analysts and sustainability planners: Updating clean energy transition strategies, decarbonization pathways, and investment priorities.

Public-private partnerships (PPP) in Green Technologies: Aligning innovation with SDG-7, SDG-9, SDG-12, SDG-13, SDG-17 goals.

Farmers and Rural Communities (Long-term)

Agro-energy companies: Potential use of green fuels in decentralized rural energy models.

Waste biomass suppliers: Utilization of biomass-derived graphene aerogels and naturally available sunlight helped the rural communities from a circular economy model.

- **Academic Partner Name:**
IIT Jodhpur

- **Faculty Name:**
Kumud Malika Tripathi, DBT Ramalingaswami Faculty Fellow. (Faculty Mentor: Dr. Meenu Chhabra)

- **Overall Cost:**
12500000

- **Financial Benefits realised:**

  Reduced Carbon Penalty Costs: The technology enables efficient capture of $CO_2$ and conversion to green fuels. Which helps industries to avoid or minimize the carbon tax liabilities and penalties under existing or future emission trading schemes. - Value from Waste $CO_2$: Converts waste $CO_2$ from industrial emissions into commercially valuable green fuels (e.g., methanol, ethanol and C1 C2 hydrocarbons), creating new revenue streams. - Lower Energy Input Costs: Utilization of naturally available sunlight for photocatalysis process reduces the overall energy cost. - Highly Recyclable Catalyst: The recyclable use of 2D-3D heterostructure- based green catalyst synthesized from waste biomass improves durability and reduces catalyst replacement frequency, cutting operational cost. - Cost-effective Decarbonization: Provides an economically viable pathway for industries to meet sustainability targets without large infrastructure overhauls.

- **TRL:** 6

- **Situation:**

  The ever-increasing level of $CO_2$ is beyond the ability of the biosphere to consume via photosynthesis, which in consequence highly contributes to greenhouse effect and climate change. Available technologies are still unproven, have high capital costs, industrially irrelevant procedures, kinetic limitations in diverse process steps and lack energy efficiency. The real technological challenge is the on-site capture of $CO_2$, sustainable and cost-effective utilization of the adsorbed $CO_2$ as green fuel/biofuel. Quantum efficiency and overall catalytic selectivity is far from practical requirement. This proposal aims to utilize 2D-3D heterostructures of graphene aerogels for the efficient capture of $CO_2$ at ambient conditions and further production of C1-C2 hydrocarbon fuels. Our approach is to improve efficiency, scalability, sustainability and cost-reduction for the transformation of industrial $CO_2$ waste into valuable products. The rich chemistry, high thermal and chemical stability, ultra-lightweight nature, tunable porosity and ease in surface engineering of carbon nanomaterials specially graphene and carbon aerogels exhibit potentials for highly efficient $CO_2$ capture and ground-breaking solar-to fuel conversion results. The efforts will also be done to design, fabricate and operate an engineering scale $CO_2$ capture and conversion reactor. To meet its national contributions and advancing economic sustainability, extensive groundwork and laboratory experiments have already been done. The present proposal has a two-fold impact towards the net-zero contributions and commercial use of captured $CO_2$ to green fuels. The role of IIT Jodhpur are below: (I) Fundamental Research, Innovation and Lab Scale Optimization (II) Development of Lab-scale Prototype (III) Technology Transfer and Intellectual Property (IV) Training & Workforce Development The role of OIL are below: (I) Technology Commercialization & Scale-up (II) Regulatory Compliance & Market Deployment (III) Technology Validation & Customer Outreach SYNERGY BETWEEN OIL and IIT JODHPUR - Lab-to-Market Pipeline → IIT Jodhpur developed innovative CO2 capture materials and technology for photocatalytic conversion into C1-C2 fuels, OIL will scale them up for real-world applications. - Industrial Testing & Validation → IIT Jodhpur will provide lab validation and the responsibilities of OIL is to conduct large-scale testing.

- **Task and Technology Used:**

  The proposal aim is to develop and optimize cost-effective and energy-efficient sustainable material and technologies to drive selective and highly efficient capture of gaseous $CO_2$ and sunlight induced direct conversion to C1-C2 fuels. The potential impact of the project is to overcome the technical challenges for $CO_2$ capture and activation for their real-world applications in an economical and eco-friendly way. Technology used: - 2D–3D Heterostructured graphene aerogel both as an adsorbent and photocatalyst: The Adsorption process is utilized for the direct capture of $CO_2$ from ambient air (without applying temperature and pressure) via physisorption in batch experiments. The selectivity of synthesized graphene aerogel towards $CO_2$ capture is achieved by appropriate surface functionalization. The same graphene aerogel is capable of harnessing solar energy and is capable for the photocatalytic reduction of atmospheric $CO_2$ to green fuels. The utilization of same graphene aerogels both as an adsorbent for $CO_2$ capture and photocatalyst for the reduction of captured $CO_2$ to C1-C2 products offer the cost reduction and efficiency improvements. - Photocatalytic Reactor System: Designed to mimic natural photosynthesis using solar energy to drive the catalytic reduction of $CO_2$ in the presence of water. - Green Synthesis Approach: Utilizes biomass or waste material for the synthesis of graphene aerogel, ensuring environmental sustainability and cost-effectiveness.

## Actions Undertaken:

Material Design and Synthesis: Developed a novel 2D–3D heterostructured graphene aerogel using green, economically viable and highly scalable synthesis methods with high surface area, ultra low density and solar light harvesting ability. We have high control over the material and process. The characteristics of graphene aerogels and 2D nanomaterials can be easily tuned by composite fabrication, surface functionalization and heteroatom doping that is not readily available in conventional materials. Lab-Scale Testing: -The Absorption process is utilized for the direct capture of $CO_2$ from ambient air (without applying temperature and pressure) via physisorption in batch experiments. Evaluated the photocatalytic performance under natural solar light for $CO_2$ reduction to green fuels such as methanol, confirming high conversion efficiency and selectivity.

## Results/Outcome:

Laboratory scale studies already showed the potential for commercialization. It will deliver an assured delivery of high-quality material, solar fuels and innovations in techniques both. It is proposed to set up an experimental pilot plant with the help of OIL for the large-scale manufacturing of 2D-3D heterostructured graphene aerogels as a base material for $CO_2$ capture and conversion to green fuel. The technical and commercial feasibility of large-scale production of graphene aerogel both as an adsorbent and photocatalyst will be assessed. This will increase the resilience of the Indian government and common people against climate change. Our final objective is to set up a pilot plant in OIL for $CO_2$ capture and production of C1-C2 green fuels from the captured $CO_2$ to test the environmental, financial and social feasibility of solar-to-fuel technology with an improved quality and at reduced costs.

## Impact:

- Environmental Impact: The technology have significant potential to reduce the industrial $CO_2$ emissions by converting them into valuable green fuels, contributing to India's climate goals and commitments under the Paris Agreement.
- Financial Impact: The technology offers a cost-effective solution for carbon capture and utilization (CCU), and can enable industries to save on carbon taxes and generate income through fuel production and potential carbon credits.
- Research & Innovation Capacity: The technology can further strengthens national R&D in clean energy technologies through the development of advanced green catalysts and artificial photosynthesis systems, fostering interdisciplinary innovation.
- Industrial Sustainability: The technology can provides a scalable pathway for energy-intensive sectors (oil, chemical, steel) to transition toward cleaner operations without major overhauls in infrastructure.
- Global Competitiveness: The technology once matured can positions India as a leader in carbon-to-fuel innovation, supporting domestic technology development and potential export of green technologies.

## Describe Industry-Academia Partnership Challenges Faced During this Collaboration:

The industry–academia collaboration with the oil sector faced minimal challenges, thanks to strong alignment and mutual goals. Minor delays occurred due to funding approvals for specialized instruments and the allocation of dedicated experimental space. Overall, the partnership is smooth and highly cooperative.

## Key Learnings:

- Timely funding and access to dedicated research space are critical to accelerate lab-to-pilot transitions.
- Early engagement and continuous communication between industry and academia foster alignment of expectations and deliverables. - Flexible IP frameworks and streamlined administrative processes enhance trust and collaboration.
- Policy makers should establish fast-track funding schemes, shared R&D infrastructure hubs, and incentivize industry participation in deep-tech pilot projects to drive innovation in clean energy and $CO_2$ utilization.

# IIT GANDHINAGAR

## Digitisation and Automation of Corneal Cross-Linking Device

**Type of partnership:** Industry Sponsored Research Project

**Start Year of Partnership:** 2025

**Leader Name:** Prof. Uttama Lahiri (Electrical Engineering Department)

uttamalahiri@iitgn.ac.in

**Current Status:** In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:** Mr. Rajesh Pedamallu (General Manager, Biotech Vision Care)
- **Academic Partner Name:** IIT Gandhinagar
- **Faculty Name:** Uttama Lehri
- **Overall Cost:** 2400000
- **Financial Benefits Realised:** Realised: Our solution will save time, increase the throughput and offer higher precision of the Corneal Cross-Linking procedure. This offers a cost- effective solution with augmented features making it ahead of the competing solutions.
- **TRL:** 7

- **Situation:** Digitisation and Automation of Corneal Cross-Linking Device.
- **Task and Technology Used:** Electronics-based Automation of the Corneal Cross- Linking procedure.
- **Actions Undertaken:** Biomarker-based Ultraviolet (UV)-beam displacement mechanism with automated power control of Corneal Cross-Linking Device 2). Digitized Graphical User Interface for electronic control of the system and data visualization.
- **Results/Outcome:** Demonstrated the output in terms of a medium fidelity prototype of the Automated Corneal Cross-Linking Device.
- **Impact:** Our solution would enhance the precision of the Corneal Cross-Linking procedure, along with the safety and user experience during the procedure.
- **Describe Industry-Academia Partnership Challenges Faced During this Collaboration:** NA
- **Key Learnings:** Making the industry-specific solutions while adhering to the industry standards.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250

# MANIPAL ACADEMY OF HIGHER EDUCATION

## Phase 1: PranAI Solutions for Affordable and Accessible Health-care Across Generations, Phase 2: AI-Based Coronary Artery Disease Diagnosis and Prediction System

**Type of partnership:** Industry Sponsored COEs

**Start Year of Partnership:** 2024

**Leader Name:**
Mr. Manjunatha Maiya (Manager, Philips India Private Limited, Philips Innovation Campus, Bengaluru)
manjunatha.maiya@philips.com

**Current Status:** In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  Target audience of the solution: Radiologists, Interventional Cardiologists, Researchers in cardiology (Scientific field), Secondary Health centres, Tertiary health centres and resource limited health care facilities.
  Benefits of the partnership: Easy clinical validation of the developed solution, integrating the solution to the existing cardiology workflow, developing the work as software as Medical Device (SaMD)
- **Academic Partner Name:**
  It is a consortium comprising MAHE, IIT Madras, IIT Delhi, IISc and AIIMS Delhi
- **Faculty Name:**
  Dr. Ganesh P, KMC, Manipal, MAHE; Dr. Manjunath K N, MIT, Manipal, MAHE
- **Overall Cost:**
  3320000000
- **Financial Benefits Realised:**
  In phase 1, MAHE Manipal received ₹81.3L from initial seed grant of ₹2Cr training, and student immersion programs. Experiential Outreach and Monitoring and Evaluation: Involves outreach activities, seminars, and conferences, costs for creating progress reports and assessments of outcomes.
- **TRL:** 8

- **Situation:**
  Manipal Academy of Higher Education has become one of the Research groups in the prestigious Artificial Intelligence Center of Excellence project in Health by the Ministry of Education, GoI. This is part of the vision of our honourable prime minister to create three major centres of excellence in India. MAHE Manipal is working on “heart disease diagnosis and prediction system development using AI”. It has successfully demonstrated its proof of concept (POC) in phase 1 and now qualified for phase 2. It has strategic plan for five years to bring the work outcome into a clinical solution in large scale, India wide. Phase 1 included five academic institutes from MAHE, Philips, DHO Udupi and Manipal Hospitals Bengaluru. Phase 2 includes MAHE Manipal, AIIMS Delhi, IIT Delhi, IISc Bengaluru and IIT Madras for effective implementation, scaling up and deploying the AI solutions nationwide. MAHE is the only private university in India considered by Ministry of Education, GOI in this consortium in the creation of Center of Excellence in AI. The corporate companies are involved in providing the required technical expertise, helping to develop the work output into software as Medical device, integrating to the clinical workflow and market expansion (under discussion).
- **Task and Technology Used:**
  The task was to segment the coronary artery accurately and to say whether artery has disease. The technology used is Deep learning pipeline development using Python programming language. The expected outcome is the good performance of the model with multi centre dataset and easy clinical adoption of the solution.

- **Actions Undertaken:**

  We had defined the objective for a year as per project management body of knowledge and as per the standards of AI work in medical imaging. We have developed the POC on coronary artery segmentation.

- **Results/Outcome:**

  We have achieved the satisfactory results in POC which will be a foundation work for further research and development of AI in Cariology image analysis.

- **Impact:**

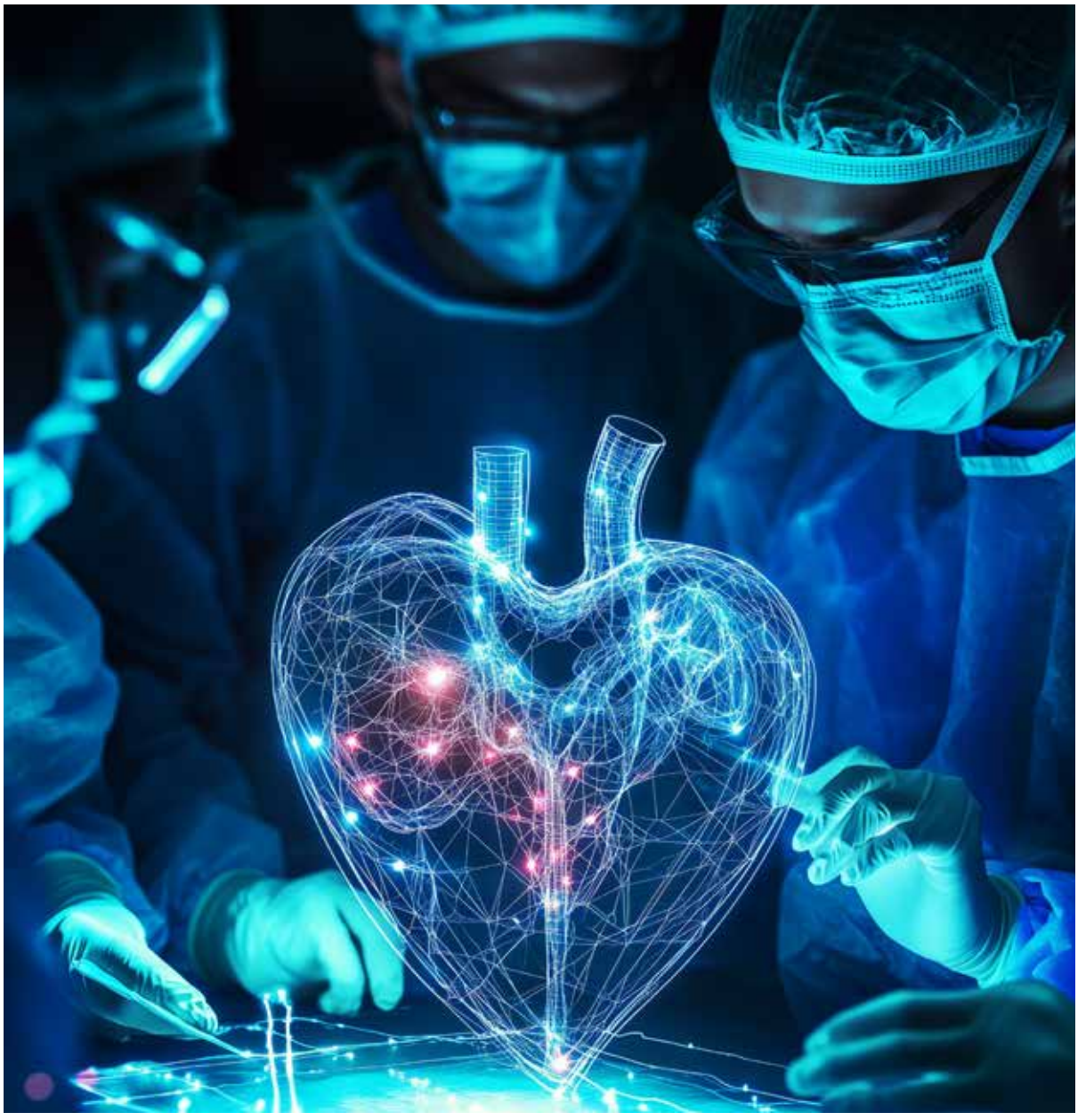
  This work has societal impact, economic impact and scientific impact in the long run in Indian Cardiology patient context. Diagnosis at a reduced cost is possible in few minutes.

- **Describe Industry-Academia Partnership Challenges Faced During this Collaboration:**

  Discussions, negotiations and reaching a common consensus within just 3-4 months during the project was tough for both Academic Institutes and Industry partner.

- **Key Learnings:**

  Academic institutions are capable of handling the business requirements from industries. The knowledge generated from research and innovation has the potential to become new policies for the radiology and cardiology centers in tier-1 and 2 cities of India.



# BITS PILANI K K BIRLA GOA CAMPUS

## Development of a Laser Assisted CVD Reactor System as an Addition/Alternative to Siemens CVD Reactor for Polysilicon Production

**Type of partnership:** Industry Sponsored Research Project

**Start Year of Partnership:** 2024

**Leader Name:**
Mr. Prasanth Sakhamuri (ASM-HHV Engineering Ltd)
prasanth@hhv.in

**Current Status:** In-Progress

- **Target Audienc /Major Users and Beneficiaries of the Partnership:**
  a. Major Users: Industry – Solar and Semiconductor Industries (including ASM-HHV).
  b. Beneficiaries of the Partnership: Academics: Research leads to publications as well as patents Industry: Patent and end product to be scaled up; technology demonstration and product Development.
- **Academic Partner Name:**
  BITS Pilani
- **Faculty Name:**
  Prof. Amol Deshpande (PI) and Other 5 faculties from different campuses as Co-PI
- **Overall Cost:**
  13100000
- **Financial Benefits Realised:**
  The outcome can help in revolutionizing the polysilicon production process and reducing the current cost of production significantly.
- **TRL:** 5

- **Situation:**
  Polysilicon is currently produced in a Siemens Chemical Vapor Deposition (CVD) reactor, where trichlorosilane (TCS) reacts with hydrogen at 1150°C. This batch process is energy-intensive and requires complex multi-stage heating of silicon rods. It also produces byproducts like silicon tetrachloride (STC), which must be converted back to TCS in additional steps. To address these issues, Hariharan and Ravi proposed a laser-assisted CVD (L-CVD) reactor that uses laser heating to reach 1250°C rapidly, simplifying heating and enabling effective STC use. However, L-CVD's performance needs detailed study and comparison with the Siemens process, and forms the basis of this work. Role: BITS – Design a L-CVD reactor for polysilicon production at lab scale, Carry out CFD simulation to develop the robust design and overall process. Demonstrate the process at lab scale. Industry – Demonstration at industry scale and provide help in developing required set-ups. US Scientists: Technical input in designing and modeling/simulation of the newly proposed LCVD system.
- **Task and Technology Used:**
  The expected outcome is the robust design of: L-CVD reactor system for polysilicon production and its successful demonstration under robust operating conditions.
- **Actions Undertaken:**
  Inputs are provided by US Scientists who have experience in working in this field. Design is developed and set-ups are being fabricated/installed.

### Results/Outcome:

2kW lab based Laser based CVD reactor system; Proposed design for industrial scale

### Impact:

By leveraging laser-based precision heating and localized energy delivery, this innovation could significantly enhance process efficiency, reduce energy consumption, and lower material waste. The outcome may dramatically cut production costs while increasing throughput and scalability. Ultimately, this advancement could accelerate the adoption of cleaner, more sustainable manufacturing practices in high-demand sectors like solar photovoltaics and semiconductors, positioning it as a game-changer in the global polysilicon industry.

### Describe Industry-Academia Partnership Challenges Faced During this Collaboration:

Industry is focused on the product development with dedicated team of experts and expects quick solutions. While In Academia, faculties/researchers have expertise/capabilities but due to other academic responsibilities, they need to work on the problem with relatively fresh research candidates. Hence, the providing relatively quick solutions becomes challenging.

- More regular visits/meetings between Academia and industry experts can help both industries (solving their critical operational/other issues) and academicians (working on real issues and including them in their teaching to the students)

### Key Learnings:

- Govt should encourage industry-academia collaboration at all levels (including private universities).
- Industries should approach academic/research institutes in India to find solutions to their problems before going for products/processes from other countries
- Academicians/Researchers in India should start focusing on solving industrial problems with relatively equal focus on basic research.

# FOUNDATION FOR SCIENCE INNOVATION AND DEVELOPMENT

## Oil-Less Bearing Centrifugal Compressor (Magnetic Bearing)

**Type of partnership:** Industry Sponsored COEs

**Start Year of Partnership:** 2023

**Leader Name:** Dr Suraj Abdan, Deputy General Manager

suraj.abdan@kirloskar.com

**Current Status:** In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:** Chiller applications in marine (Indian Navy & Coast Guard), pharma and food processing industries for where air quality and maintenance free performance is critical to quality.
- **Academic Partner Name:** BITS Pilani
- **Faculty Name:** Prof. G Narayanan
- **Overall Cost:** 68271605 (unit)
- **Financial Benefits Realised:** 30% reduction in price compared to competition, upto 70% indigenous development of the product. Product launch in December 2025 with a market projection of Rs. 160 - 180 cr by 2028 in Marine, Pharma and food processing industries (CAGR - 25%)
- **TRL:** 6

- **Situation:** Polysilicon is currently produced in a Siemens Chemical Vapor Deposition (CVD) reactor, where trichlorosilane (TCS) reacts with hydrogen at 1150°C. This batch process is energy-intensive and requires complex multi-stage heating of silicon rods. It also produces byproducts like silicon tetrachloride (STC), which must be converted back to TCS in additional steps. To address these issues, Hariharan and Ravi proposed a laser-assisted CVD (L-CVD) reactor that uses laser heating to reach 1250°C rapidly, simplifying heating and enabling effective STC use. However, L-CVD's performance needs detailed study and comparison with the Siemens process, and forms the basis of this work. Role: BITS – Design a L-CVD reactor for polysilicon production at lab scale, Carry out CFD simulation to develop the robust design and overall process. Demonstrate the process at lab scale. Industry – Demonstration at industry scale and provide help in developing required set-ups. US Scientists: Technical input in designing and modeling/simulation of the newly proposed LCVD system

### Task and Technology Used:

The collaboration is delivering a first-of-its-kind centrifugal compressor platform in India using a suite of advanced technologies:

- Active Magnetic Bearings (AMB) for contactless operation and minimal maintenance.
- High-Speed Induction Motor (20,000 rpm) for compact and efficient drive.
- High-Frequency Variable Speed Drive to ensure dynamic speed control.
- Optimized Aerodynamic Impeller Design using CFD Tools KPCL led the complete system architecture, sub-system integration, and prototype development. FSID @ IISc offered mentoring across AMB dynamics, system modelling, and control design. Testing was distributed—AMB at IISc, motor at vendor sites, mechanical and thermal components at KPCL, and rotor dynamics through an international expert. In parallel, a fellow industry partner in SamridDHI supported high-frequency VFD development. This holistic engagement enabled the development of an advanced system from the ground up, marrying industrial execution with academic depth.

### Actions Undertaken:

The project was managed using structured New Product Development (NPD) processes tailored for complex R&D. Key actions included:

- Joint Program & Project Management: FSID coordinated with KPCL for project planning, milestone tracking, and cross-functional team alignment.
- Technology Mentoring & Design Reviews: IISc faculty and FSID experts regularly reviewed subsystem designs, ensuring technical soundness and manufacturability.
- IP Management: A structured process led by FSID and jointly executed resulted in 3 patents and 1 trademark filing from novel innovations during the project.
- Market Research & Customer Voice: KPCL and FSID collaborated to identify end-user requirements, segment opportunities, and design-to-value strategies, feeding into product and go-to-market planning.
- Skilling & Team Building: FSID supported the induction of domain experts within KPCL and enabled knowledge transfer via immersive interactions with academic mentors.

### Results/Outcome:

The partnership has successfully yielded an engineering prototype that integrates:

- Indigenous electromagnetic bearings, high-speed motor, drive electronics, and aerodynamic components.
- Complete system integration onto a single shaft, with innovative thermal management using the working refrigerant.
- Full subsystem validation and system-level performance testing currently underway at KPCL The outcomes demonstrate India's ability to build and validate a world-class oil-free compressor solution—designed, developed, and tested indigenously.

### Impact:

Technological: The project has demonstrated India's capacity to deliver complex electromechanical systems entirely indigenously. Over 70% of the BOM is locally sourced.

- Market: Offers a competitive alternative to imported compressors at 30% lower cost, aligned with domestic and export demands, especially in a market growing at 25% CAGR.
- Research & IP: Generated 3 patents and 1 trademark, contributing to India's innovation ecosystem.
- Environmental: Oil-free and high-efficiency design contributes to reduced lifecycle emissions and maintenance, aiding sustainability goals.

### Describe Industry-Academia Partnership Challenges Faced During this Collaboration:

Several challenges were navigated through mutual trust and alignment:

- Low National R&D Spending: Encouraging industry to invest beyond product sales into deep R&D was initially difficult. Government co-funding mitigated risk and incentivized participation.
- Talent & Expertise Gaps: Finding India-based experts with hands-on experience in AMBs, high-speed motors, and rotor dynamics was a challenge; this was addressed by leveraging both in-house and external specialists.
- Project Risk & Integration: Managing system-level risk across domains was difficult, but collaboration between KPCL's engineering teams and FSID/IISc mentors enabled proactive risk mitigation.
- IP Awareness: Creating a culture of proactive IP generation and protection required deliberate mentoring and process discipline.

**Key Learnings:**

Provide Structured Co-Funding Programs: Risk-sharing by the government (as in SamridDHI) is crucial to trigger early industry participation in complex R&D. 2. Strengthen Industry-Academia Interfaces: Centre of Excellence with programmatic and mentoring capabilities bridge capability gaps and accelerate innovation. 3. Encourage Local Capability Building: Promote indigenous supply chains and skills through targeted incentives and training programs. 4. Institutionalize IP Culture: Policies that support IP education, filing support, and commercialization pathways can convert innovation into business impact.

# PSGR KRISHNAMMAL COLLEGE FOR WOMEN

## GRG-Elgi Digital Innovation Dojo

**Type of partnership:** Industry Sponsored COEs

**Start Year of Partnership:** 2022

**Leader Name:** Dr Jairam Varadaraj, MD, Elgi Equipments Ltd

jairamv@elgi.com

**Current Status:** In-Progress

- **Target Audience/Major users and beneficiaries of the Partnership:** Target Audience – Students, Employees of Elgi Equipments, Elgi Equipments
- **Academic Partner Name:** PSGR Krishnammal College for Women
- **Faculty Name:** Dr Vandana Madhavkumar
- **Overall Cost:** 3000000
- **Financial Benefits Realised:** NA
- **TRL:** 8

- **Situation:**

PSGR Krishnammal College for Women, a Coimbatore-based autonomous arts and science college, recognized as a 'College of Excellence' by the University Grants Commission, and Elgi Equipments, one of the world's leading air-compressor manufacturers, established the 'GRG-ELGi Digital Innovation Dojo' at the college's Campus in Peelamedu, Coimbatore in 2022. This part of ELGi's digital transformation strategy based on the premise of 'Experiment, Start Small & Scale Fast'. The objective of the partnership was to provide opportunities for women to acquire specialized technical skills while defining solutions and exploring areas of development, ultimately resulting in valuable industry experience for the participant students, together with workable solutions and fresh perspectives for ELGi Equipments.

The MD, Dr Jairam Varadaraj believes that collaboration is the cornerstone of business success. Tomorrow's talent will thrive when industry and academia join forces to drive impactful research, foster innovation, and create solutions that shape society and business alike. This initiative aims to equip graduates with real-world experience, ensuring they enter the workforce skilled and confident. The Digital Innovation Dojo represents more than just upskilling—it's a commitment to empowering young women, building a future-ready talent pool, and accelerating our shared digital transformation journey.

- **Task and Technology Used:**

The 'GRG-ELGi Digital Innovation Dojo' equipped with the necessary computational systems and software from ELGi, engages approximately 20 interns at any given time. The Dojo or learning center embraces extensive and effective use of the agile scrum framework for project management and technology advancements. Also, all interns have the opportunity to work on technology platforms spanning Artificial Intelligence (AI), Machine Learning (ML), Virtual/Augmented reality, Mobile App Development, Web App Development, Big Data Analytics and Robotic Process Automation (RPA). The Undergraduate and Post-Graduate students are also able to interact, learn, work, and be mentored by ELGi's industry leaders across the globe, empowering them to explore various employment opportunities in the digital transformation arena. As of now, around 200 students completed their internship / projects at DOJO. Interns gain hands-on experience with advanced technologies, including:

- Artificial Intelligence (AI) & Machine Learning (ML).

- Virtual & Augmented Reality (VR/ AR).
- Robotic Process Automation (RPA) Additionally, students receive global mentorship from ELGi's industry leaders, offering exposure to diverse career pathways in digital transformation. This initiative bridges academia and industry, preparing students for the evolving demands of the tech-driven workforce.

### Actions Undertaken:

Problems of process automation are provided to a batch of 32 to 40 students, who are divided into teams. Students were divided into morning and evening sessions, with approximately half (approx. 20) students actively participating in both the shifts and the other half in the afternoon shift. Each batch consists students from various disciplines:

- B.Sc. Computational Sciences,
- B.Sc. Mathematics,
- B.Sc. Physics,
- B.Com Business Analytics,
- M.Sc. Data Analytics,
- MBA. Each batch was divided into 10 project teams, based on academic expertise and project alignment. Each team comprises of 3 undergraduate and 6 postgraduate students. Teams were jointly guided by - An internal academic mentor from Computational Sciences and an external industry mentor from ELGi, assigned based on project scope. Daily online scrum meetings are held to review progress, clarify doubts, and maintain project momentum A Non - Disclosure Agreement (NDA) was signed by students and faculty mentors to ensure confidentiality and protect intellectual property throughout the project lifecycle. A total of 304 students from 8 batches successfully completed their internships between September 2022 and March 2025. The 9th batch is currently ongoing.

### Results/Outcome:

CS, IT, and BCA students: Developed web and mobile applications.

- M.Sc. Data Analytics students: Built AI-integrated web/mobile applications.
- B. Com Business Analytics & M.Sc. Data Analytics students: Created Power BI dashboards for descriptive analytics.
- MBA students: Managed operational activities at Dojo, including coordination, resource management, and progress tracking to align with ELGi's expectations.

### Impact:

- Establishment of a structured internship ecosystem connecting academia and industry.
- Successful completion of 8 internship batches, involving 304 students and 120 real-time projects.
- A total of 304 students contributed to ~120 industry-focused projects
- Cross-disciplinary collaboration among undergraduate and postgraduate students, fostering peer learning.
- 25 students secured internships or placements at companies such as:
  - o ELGi Equipments Ltd o NetXAI
  - o Fintech Pvt. Ltd
- Recognition of student work in international journals, marking the academic impact of industry-linked projects Two successful projects were recognized as research contributions and have been published in Scopus-indexed journals.
- Placement of students in reputed companies, validating the effectiveness of the program.

### Describe Industry-Academia Partnership Challenges Faced During this Collaboration:

1 Balancing theoretical knowledge with practical implementation was difficult, especially for students with non-technical backgrounds.

2 Maintaining consistent project momentum while accommodating academic schedules was sometimes challenging.

3 It was challenging to align real-world industry problems with academic knowledge

### Key Learnings:

1 The dual mentorship (academic + industry) ensured both technical and business perspectives were incorporated.

2 The framework can be replicated with other industries and colleges.

3 Combining undergraduates with postgraduates (including MBA students initiated peer learning.

# SOMAIYA SCHOOL OF ENGINEERING

## Development of a High-Performance UAV Using Advanced Composite Materials

**Type of partnership:**
Industry Sponsored Research Project

**Start Year of Partnership:**
2024

**Leader Name:**
JSM Composites Pvt. Ltd.

srajan@jsmcomposites.in

**Current Status:**
Completed

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  Defense, Agriculture and Cinematography
- **Academic Partner Name:**
  Mr Srajan Kumar
- **Faculty Name:**
  Luckman Muhmood
- **Overall Cost:**
  350000
- **Financial Benefits Realised:**
  NA
- **TRL:** 6

- **Situation:**
  The objective was to design and fabricate a composite UAV component using industry-relevant methods. This entailed CAD modeling (with validation), generating CNC toolpaths for mold creation, performing composite layup with vacuum bagging, and curing the part under controlled conditions. The CAD Design and Modelling was conducted by KJSSE in collaboration with JSM Composites. The fabrication and QC was entirely done at JSM Composites premises.

- **Task and Technology Used:**
  To design a critical component of a UAV using composite material.
- **Actions Undertaken:**
  Design, Modelling, Fabrication, lay up, curing of the composites.
- **Results/Outcome:**
  The critical part of the UAV was fabricated.
- **Impact:**
  The project resulted in placement of the intern. The part manufactured is successfully being used in the UAV.
- **Describe Industry-Academia Partnership Challenges Faced During this Collaboration:**
  There were a few challenges in understanding the problem and delivering the right solution. Learning QC techniques using 3D scanner was also a challenge. Propper support structure for part to be manufactured was the most challenging work.

- **Key Learnings:**
  If the right mindset is with the industry and academia is there then most tasks are achievable.

# INGENERO TECHNOLOGIES (INDIA) PRIVATE LIMITED

## Development of a Commercial-Scale Carbon Capture and Utilization (CCU) Technology Based on a Patented Aqua-Based Catalyst, Scaled Up from a Lab-Scale Clean Tech Innovation

**Type of partnership:**
Industry Sponsored CoEs

**Start Year of Partnership:**
2024

**Leader Name:**
Mr. Dhiresh Mahajan, Director - Process Technology and
Mr. Abhijit Kharote, Director - Process Engineering
srajan@jsmcomposites.in

**Current Status:**
In-Progress

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  $CO_2$ emitting industries and hard to abate sectors such as, Power Plants, Steel Plants, Refineries and Petrochemical Complexes.
- **Academic Partner Name:**
  IIT Bombay, SINE incubation centre startup, UrjanovaC Pvt Ltd.
- **Faculty Name:**
  Prof Vikram Vishal and Prof Arnab Datta
- **Overall Cost:**
  17400000
- **Financial Benefits Realised:**
  NA
- **TRL:** 7

- **Situation:**
  IIT Bombay faculty and co-founders of UrjanovaC Pvt. Ltd., Prof. Vikram Vishal and Prof. Arnab Dutta have developed an innovative carbon capture technology using a patented aqua-based catalyst. Initially developed in their laboratory, the technology has been scaled to a 75 liter prototype. The catalyst enhances the solubility of CO2 in water, enabling efficient downstream reactions. Ingenero and UrjanovaC have partnered to advance this breakthrough and explore pathways for commercial-scale deployment.

- **Task and Technology Used:**
  Ingenero has explored the possibilities to optimize the reactant concentrations without affecting the basic reaction. The effect of side reactions and thereby the project feasibility was also studied and altered some of the reactants and parameters to make the technology commercially feasible. The reactant recovery and recirculation is also established to minimize the reactant consumption as well as waste stream. A demonstration of $CO_2$ capture using the patented catalyst has been done by successfully installing and running the demo unit at one of a commercial plant using live flue gas from a furnace. The pre-feasibility and feasibility study with respect to return on investment, carbon capture and utilization is successful. Post the study a Demo plant outline and design has been done to develop a Licensor package to install a pilot scale plant of 10 TPD and 50 TPD capacity. Currently the pilot plant set up activities are at advance level with some of PSUs and private establishments.

- **Actions Undertaken:**
  Ingenero collaborated with IIT Bombay professors to carry out pre-feasibility and detailed feasibility study for this technology to ensure commercial utilization in different sectors.

- **Results/Outcome:**
  Ingenero has successfully developed a commercial-ready process for capturing CO2 with a minimal footprint and low energy consumption, converting emissions into valuable, marketable products. Both have also progressed through multiple stages of

technology development and deployment, actively engaging with hard-to-abate sectors through collaborations with leading industrial players such as BPCL, Dalmia Cement, SAIL, GPIL, and others. Over the past year, IIT Bombay and UrjanovaC showcased this breakthrough technology at India Energy Week 2025 and was honoured with several prestigious national-level awards, like: * Received the OPENAIR carbon removal challenge award. * Received Schlumberger award. * Winner of XCarb Competition by ArcelorMittal. * Winner of REMOVE CDR CarbonReset. * Winner of Avinya'25 - Energy Startup Challenge. * Recognized as a "Deep Tech Pioneer" by Hello Tomorrow. * Finalist of GCCA Innovandi open challenge 2024. * Finalist of MIF Innovation for India Awards. * Finalist of ONGC Startup Funding Program – Funding offered. * Finalist of PRISM (S&T). * Finalist of TIE Global Impact Award. * Finalist of IOE Seed and Leap grants – Funding offered. * Finalist of Altair Start-Up Challenge. * Winner of Avaana - Startup India - NITI Aayog AIM Grand Challenge for ClimateTech Innovation 2024-25.

### Impact:

This patented technology offers a sustainable, scalable, and energy-efficient solution for capturing and converting $CO_2$ into high-value products such as carbonates — tackling one of the most pressing environmental challenges of our time. By transforming emissions into economic assets, the technology not only contributes to significant carbon footprint reduction but also unlocks substantial financial value through commercialization and circular economy pathways. Its strong relevance to hard-to-abate sectors like steel, power, and petrochemicals positions it as one of the most viable and impactful $CO_2$ abatement strategies, directly supporting India's Net Zero targets while embodying the spirit of "Made-in-India" and Viksit Bharat. Additionally, the innovation strengthens national research capabilities and fosters industrial advancement, positioning India at the forefront of clean technology and climate leadership.

### Describe Industry-Academia Partnership Challenges Faced During this Collaboration:

The major challenges during the technology and process development were the side reactions, reactant concentration, recovery and recirculation of reactants. Team overcame these challenges by technical brainstorming, joint discussions and experimentation.

### Key Learnings:

An Industry-Academia collaboration has led to the development of an innovative Carbon Capture and Utilization (CCU) technology. To further accelerate adoption, the Government of India could consider awarding carbon credits as an incentive, making CCU implementation more economically attractive for industries. Such policy support would empower both researchers and industry stakeholders to scale the technology with continued innovation, while significantly contributing to India's journey toward Net Zero.

# ACSIA TECHNOLOGIES PVT LTD

## AI-Driven Predictive Maintenance in Automotive Powered by Acsia Co-Pilot LiLA

**Type of partnership:**
Industry Sponsored Research project

**Start Year of Partnership:**
2024

**Leader Name:**
Vasantharaj G Pillai, VP Technology & Innovations
vasanth@acsiatech.com

**Current Status:**
In-Progress

- **Target Audience / Major users and beneficiaries of the Partnership:**

  Acsia's customer in Automotive sector: Orginal Equipment Manufacturer like German OEM's, North American OEM's, Teir 1 companies, Teir 2 companies etc.

  Engineering Students & Faculty: Gained hands-on exposure to cutting-edge AI technologies in the automotive domain, improving employability and practical research skills.

  Acsia Employees: Opportunity to mentor and collaborate on real-world innovation, enhancing internal knowledge assets.

  Dealership Networks: Benefit from predictive scheduLling, improved inventory planning, and reduced downtime.

  Automobile Owners: Enjoy proactive service support, improved reliability, and enhanced user experience.

  Automotive Ecosystem: Enables sustainable operations through reduced waste, better resource planning, and alignment with green mobility goals.

- **Academic Partner Name:**
  Mar Baselios College of Engineering and Technology, Trivandrum

- **Faculty Name:**
  Vipin Kumar K C

- **Overall Cost:**
  108000

- **Financial Benefits Realised:**
  Though this is a research-stage project, the estimated financial benefits based on industry benchmarks and internal simulations are substantial: Potential Maintenance Cost Reduction: 10–15% savings for OEMs and dealerships. ROI Potential: Up to 10x return on investment when scaled commercially. Customer Retention Impact: Potential 30% increase in customer visit rates to service centers. Productivity Gains: Enhanced workforce allocation and up to 42% improvement in prediction accuracy leads to significant efficiency gains. If adopted by even a small percentage of Acsia's global OEM clientele, this solution could unlock multi-crore annual savings across the automotive ecosystem.

- **TRL:** 6

- **Situation:**
  This project was initiated as part of Acsia Technologies' focus on leveraging Artificial Intelligence to advance predictive maintenance in the automotive industry. It involved collaboration between Acsia Technologies and two academic institutions: Mar Baselios College of Engineering and IIT Palakkad. Acsia provided domain expertise, mentorship, and real-world problem statements. Students and faculty from Mar Baselios & IIT Palakkad led data modelling and algorithm design under Acsia's guidance. The goal was to co-create a model that could forecast service needs for vehicles using historical service records and connected car data.

- **Task and Technology Used:**

  To design a predictive maintenance model that could analyze vehicle service data and anticipate failures or service needs, reducing unplanned downtime for customers and improving dealership resource planning. Technology Used: AI & Machine Learning (regression and classification models); Python, Jupyter Notebook, and cloud-based AI development environments; Data preprocessing and feature engineering; Visual analytics dashboards; Optional integration of connected car IoT data (for future scaling).

- **Actions Undertaken:**

  Selected a group of final-year engineering students through academic partnerships. Collected and anonymized historic vehicle service data to ensure compliance and relevance. Designed AI models to forecast service needs and test predictive accuracy. Conducted reviews with Acsia's R&D and Technology leadership to validate outcomes. Developed a working prototype for internal deployment and pilot testing.

- **Results/Outcome:**

  Developed a predictive model with up to 42% improved accuracy compared to baseline methods. Created a proof-of-concept (PoC) dashboard that visually communicates future service demands to dealership users. Students gained hands-on R&D experience, strengthening future career opportunities. Prepared model for pilot testing with selected dealerships in FY 2025–26.

- **Impact:**

  Organizational: Expected to enable 10–15% savings in maintenance costs and better workforce scheduling. Financial: Potential for 8–10x ROI post-deployment through optimized resource utilization. Research Capability: Enhanced Acsia's internal AI development and data science capabilities. Environmental: Reduced emissions through proactive maintenance and reduced part wastage. Talent Development: Empowered students with job-ready research skills and placement opportunities.

- **Describe Industry-Academia Partnership Challenges Faced During this Collaboration:**

  Academic scheduling conflicts: Difficulty in securing student availability during active semesters due to strict academic calendars and non-flexible institutional policies. Data privacy concerns: Sharing real-world data required anonymization and legal compliance, causing delays. Infrastructure gaps: Students needed access to high-performance computing, which had to be arranged externally. Expectation mismatch: Initial lack of alignment between academic research pace and industry delivery timelines.

- **Key Learnings:**

  Encourage flexible internship windows within the academic calendar to allow students to engage in industry projects during semesters. Establish shared AI labs or sandbox environments supported by both academia and industry for smoother collaboration. Provide incentives and recognition to faculty and students contributing to industry-led innovation. Promote data sharing frameworks that allow companies to collaborate with academic institutions without legal hurdles. Include industry mentors in curriculum planning to align academic outcomes with real-world needs.

# S. P. JAIN INSTITUTE OF MANAGEMENT AND RESEARCH (SPJIMR)

## Willingness to Pay for Carbon Pricing

**Type of partnership:** Industry Sponsored Research Project

**Start Year of Partnership:** 2023

**Leader Name:**
Dr. Govinda R. Timilsina (World Bank)
monika.gupta@spjimr.org

**Current Status:** Completed

- **Target Audience/Major Users and Beneficiaries of the Partnership:**
  The findings would be helpful for Indian firms, government officials in designing the carbon pricing policies and mitigating CO2 emissions.
- **Academic Partner Name:**
  World Bank
- **Faculty Name:**
  Dr. Monika Gupta
- **Overall Cost:**
  0
- **Financial Benefits Realised:**
  Some data cannot be shared currently owing to confidentiality requirements
- **TRL:** 0

- **Situation:**
  The study tries to understand Firms' preferences to reduce their GHG emissions. The faculty was involved in preparing questionnaire, building conceptual background, analyzing the data and writing the report.
- **Task and Technology Used:**
  Some data cannot be shared currently owing to confidentiality requirements
- **Actions Undertaken:**
  Some data cannot be shared currently owing to confidentiality requirements

- **Results/Outcome:**
  Some data cannot be shared currently owing to confidentiality requirements
- **Impact:**
  Some data cannot be shared currently owing to confidentiality requirements
- **Describe Industry-Academia Partnership Challenges Faced During this Collaboration:**
  Some data cannot be shared currently owing to confidentiality requirements

- **Key Learnings:**
  The analyses offer new findings on Indian firms' behaviour and preferences for GHG emissions reduction policies and measures.

# FOUNDATION FOR SCIENCE INNOVATION AND DEVELOPMENT–CASE STUDY 2

## Willingness to Pay for Carbon Pricing

**Type of partnership:**
Industry Sponsored Research Project

**Start Year of Partnership:**
2023

**Leader Name:**
Dr. Govinda R. Timilsina (World Bank)

monika.gupta@spjimr.org

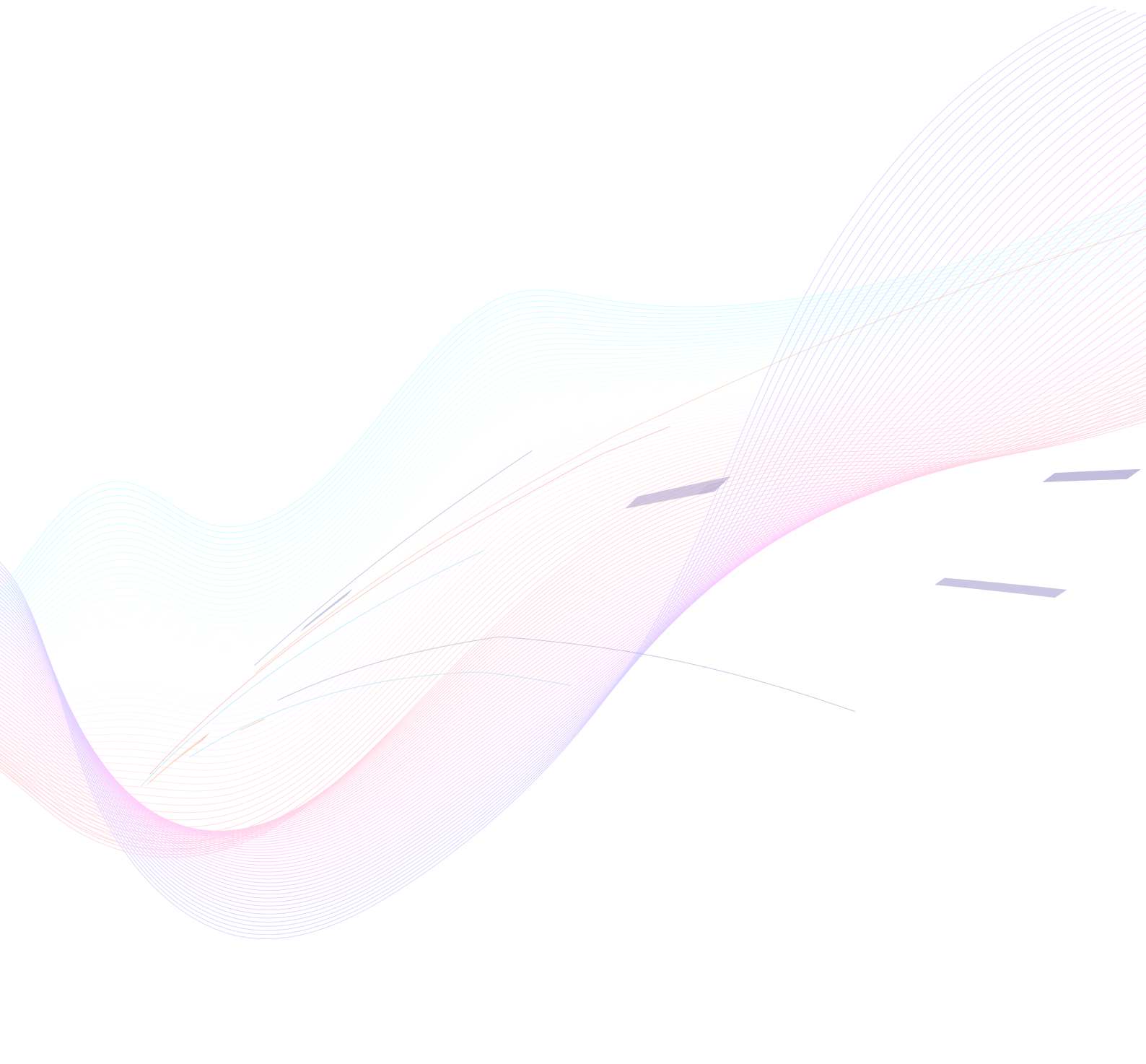
**Current Status:**
Completed

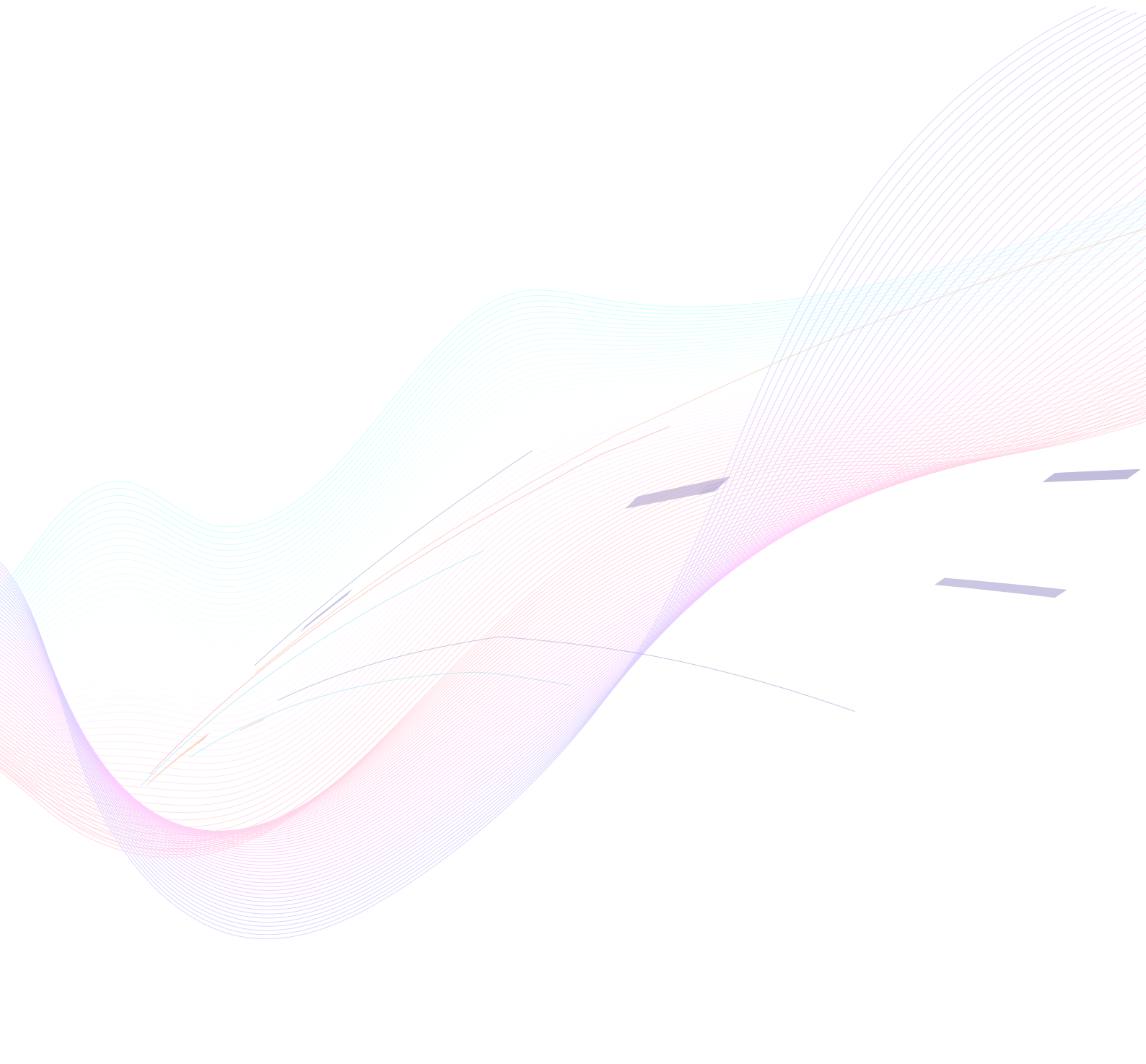
- **Target Audience / Major users and beneficiaries of the Partnership:**
  The findings would be helpful for Indian firms, government officials in designing the carbon pricing policies and mitigating CO2 emissions.
- **Academic Partner Name:**
  World Bank
- **Faculty Name:**
  Dr. Monika Gupta
- **Overall Cost:**
  0
- **Financial Benefits realised:**
  Some data cannot be shared currently owing to confidentiality requirements
- **TRL:** 0

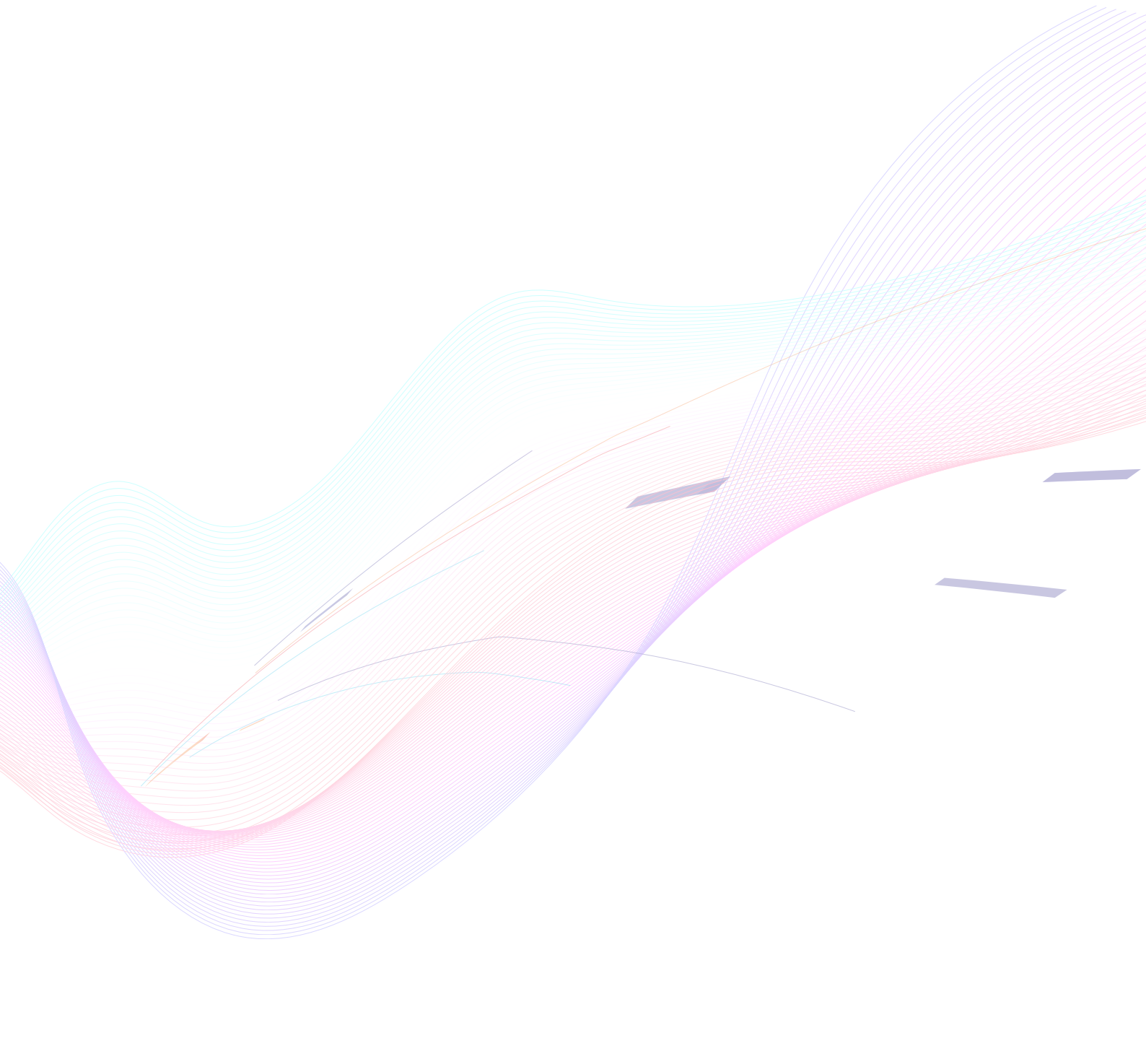
- **Situation:**
  The study tries to understand Firms' preferences to reduce their GHG emissions. The faculty was involved in preparing questionnaire, building conceptual background, analyzing the data and writing the report.
- **Task and Technology Used:**
  Some data cannot be shared currently owing to confidentiality requirements
- **Actions Undertaken:**
  Some data cannot be shared currently owing to confidentiality requirements

- **Results/Outcome:**
  Some data cannot be shared currently owing to confidentiality requirements
- **Impact:**
  Some data cannot be shared currently owing to confidentiality requirements
- **Describe Industry-Academia Partnership Challenges faced during this collaboration:**
  Some data cannot be shared currently owing to confidentiality requirements

- **Key Learnings:**
  The analyses offer new findings on Indian firms' behaviour and preferences for GHG emissions reduction policies and measures.







Confederation of Indian Industry

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the development of India, partnering Industry, Government and civil society through advisory and consultative processes.

CII is a non-government, not-for-profit, industry-led and industry-managed organisation, with around 9,700 members from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 365,000 enterprises from 318 national and regional sectoral industry bodies.

For 130 years, CII has been engaged in shaping India's development journey and works proactively on transforming Indian Industry's engagement in national development. CII charts change by working closely with the Government on policy issues, interfacing with thought leaders, and enhancing efficiency, competitiveness, and business opportunities for industry through a range of specialised services and strategic global linkages. It also provides a platform for consensus-building and networking on key issues.

Through its dedicated Centres of Excellence and Industry competitiveness initiatives, promotion of innovation and technology adoption, and partnerships for sustainability, CII plays a transformative part in shaping the future of the nation. Extending its agenda beyond business, CII assists industry to identify and execute corporate citizenship programmes across diverse domains, including affirmative action, livelihoods, diversity management, skill development, empowerment of women, and sustainable development, to name a few.

For 2025-26, CII has identified "Accelerating Competitiveness: Globalisation, Inclusivity, Sustainability, Trust" as its theme, prioritising five key pillars. During the year, CII will align its initiatives to drive strategic action aimed at enhancing India's competitiveness by promoting global engagement, inclusive growth, sustainable practices, and a foundation of trust.

With 70 offices, including 12 Centres of Excellence, in India, and 9 overseas offices in Australia, Egypt, Germany, Indonesia, Singapore, UAE, UK, and USA, as well as institutional partnerships with about 250 counterpart organisations in almost 100 countries, CII serves as a reference point for Indian industry and the international business community.

**Confederation of Indian Industry**
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